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RURAL EDUCATION.

We are publishing in this issue an account of a system of education evolved for the training of teachers for service in Malay vernacular schools. Although there is nothing new in the system described, the experiments in rural education which are being conducted at this centre should be of interest to those familiar with the subject. In our tropical colonies where the population is mainly engaged in the production of indispensable agricultural raw materials the evolution of a sound system of rural education is undoubtedly a question of very vital importance. Indeed, it may even be said that the ultimate welfare and prosperity of such colonies depend a great deal upon its efficiency. There are various aspects of the subject which could be considered, but it is intended here only to refer briefly to a system of rural instruction in vogue in elementary schools and to discuss its suitability with regard to the development of peasant agriculture.

Strictly speaking there should be no definite teaching of agriculture in elementary schools. Assuming, however, that the child receives a sound grounding in arithmetic and in expressing his ideas in English or in the vernacular of the country, he can be drawn by means of observation lessons and class reading to "take an intelligent interest in the phenomena of air, soil and water, and in the life of plants and animals. This would, in turn, lead him gradually to exercise effectively his powers of observation and reason in watching the everyday life around him." Such a scheme of rural education has long been recognised and has been put into practice in many elementary schools. To be carried out successfully, however, and in a thoroughly interesting manner, the teachers should be taught carefully themselves and be prepared to present their knowledge the result of which would not be the mere repetition by the pupil of meaningless words and phrases. The teaching should primarily be connected with the life of the child, his daily experience and his surroundings. The books used should be very carefully selected and should contain as much information as possible dealing with the child's environment. Lessons should be illustrated by means of plants in pots and boxes and by practical work in school gardens. The latter, specially, will serve as a prolific source of arithmetical examples with which the interest of the pupil will be actively and personally

concerned. With regard to the pursuit of "nature study" it is of particular importance that proper attention should be given to the general facts of nature that have their existence in the districts served by the school while the active work in relation to these will include the making of notes, drawings and paintings by the pupil and the keeping of simple records. If this method of teaching is properly carried out the necessary agricultural bias will be provided and the pupil will be prevented from becoming dissociated with the useful illustrative circumstances which surround him.

This briefly accounts for a system of instruction which exists in a number of elementary schools in the West Indies, and in other parts of the tropics. Assuming that the teaching has been done efficiently, will such a system in anyway benefit a child who is going to take up agriculture? The most that can be expected from such a child is that he will possess when leaving school a useful elementary knowledge of the plant and animal life of his surroundings. This knowledge, however, will be inadequate to fit him for his work on the land or as a peasant proprietor. If he leaves school at an early age his agricultural training is bound to be influenced by methods of husbandry, however antiquated, which he may observe practised in the district in which he happens to live while much that he may have learnt at school will probably soon be forgotten. It seems important therefore to consider whether a continuation system of rural education can be evolved by which children who have left school may be taught the rudiments of agriculture, such as simple methods of crop husbandry involving the use of modern implements and elementary facts about plant and animal diseases and sanitation. Farm schools divided into acre plots where every type of crop can be grown and studied in the field, will afford not only useful demonstration centres, but centres where an efficient type of agricultural instructor might be trained. Where such farm schools are established they turn out both excellent teachers and men with knowledge which should help them to become good agriculturists. The formation of agricultural district societies should be encouraged as such societies, if properly organised, play an important part in the dissemination of agricultural knowledge amongst peasant proprietors. The principle evolved in the United Kingdom whereby children have been encouraged to form Young Farmers' Clubs might also be studied in relation to conditions obtaining in the tropics.

In spite of all that has already been written and of numerous schemes put forward, the rural education of the primary agricultural producer still affords many problems which require solutions. It is hoped, therefore, that the subject will be brought up and ventilated at the next Agricultural Conference. Attention for instance might be paid to the parts that should be played respectively by the Departments of Agriculture and Education and the Research Stations in the furthering and improvement of rural education in the tropics. The problem will naturally vary with the degree of development attained in those parts of the tropics where such educational problems may arise. The main principle to be followed, however, is that the object of rural education should, as far as possible, fit the primary agricultural producer with knowledge which will enable him to exercise some technical control over his methods of farming or which will "improve his technical skill in the practical handling of his land, stock and crops." In addition he should also know something of the "relationship between landlord and tenant, the organisation of credit and co-operation and the best market for buying and selling." A sound system of rural education which would enable the natural resources of the land to be developed and utilised as thoroughly as possible is therefore necessary to produce that state of a happy and prosperous peasant community, so essential to our tropical Empire, which is to a large extent in the hands of peasant proprietors.

WEST INDIAN CONFERENCE.

The Proceedings of the West Indian Conference of Agricultural Officers, 1930.

THE Proceedings of the West Indian Conference of Agricultural Officers which was held at the Imperial College of Tropical Agriculture at the end of January, 1930, have been issued. The Proceedings are divided into three Parts; Part I, in the form of a General Report deals with information of an introductory character which is followed by the Findings and Acknowledgments. The Findings are sub-divided under subjects which include the Canadian Trade in Fruit and Produce, Soil Research, Experimental Programmes, the Cane Variety Problems of the West Indian Region, the Reports of the Sub-Committees appointed, and other matters. Part II, consisting of addresses, papers and discussions, is divided into the six days during which the Conference sat. Under each day will be found the addresses or papers given, followed by the discussions which have been summarised under special headings. The sequence of the subjects treated is the same as that of the Findings. Part III consists of six separate appendices, amongst which will be found the Reports of the Plant Quarantine and Field Experiments Sub-Committees, and detailed programmes of work of the Departments of Agriculture submitted by the Colonies concerned. The Proceedings (54 pages, price 2*s*.) can be obtained on application to the Editor, *Tropical Agriculture*, Imperial College of Tropical Agriculture, Trinidad, B.W.I.

GRAPEFRUIT PRODUCTION.

Grapefruit Production in Trinidad.

[*The following article is based on an address entitled "Notes on Grapefruit" which was delivered by Mr. W. S. E. Barnardo,* M.A., *to the Agricultural Society of Trinidad and Tobago, and which was published in the Proceedings of the Society, Vol. XXX, Part 9, pages* 330-339. *Through Mr. Barnardo's kind permission photographs of his grapefruit plantation were taken and are reproduced in this issue of the Journal. The article is published in the hope that it will be useful to all those interested in the practical problems of grapefruit cultivation in the West Indies, and in those parts of the Tropics where the fruit is grown under natural rainfall and not under irrigation.*—ED.]

Location and Establishment of Plantation.

The property which consists of a fifteen-acre block of undulating land, is surrounded on the north, south and east by Government Reserve Forest, and on the west by a high ridge of thick Lastro which protects it from the wind. The soil is a rather heavy clay and the annual rainfall averages about 100 inches. The property was originally under cocoa but as the trees failed to thrive they were felled in 1921. After consultation with the Department of Agriculture the area cleared was planted with 100 grapefruit plants at 18 feet by 20 feet which had been budded from trees of the Marsh variety. Subsequent plantings took place in 1922 and in 1923 but the trees were lined at 20 feet by 20 feet instead of the original distance. All recent plantings have been carried out on the equilateral triangle system of lining at 30 feet by 30 feet as this appears to be the best distance for the rainfall and soil conditions prevailing on the plantation. It has also been observed that the branches of nine to ten-year old trees planted at 20 feet by 20 feet are already showing signs of meeting.

Propagation of the Trees.

For the first three years the planting material was supplied by the local Department of Agriculture but subsequently nurseries were made and the following methods for securing the necessary planting material are recommended by the owner :—

Seeds and Seed Beds.

Seeds should be selected from the hardiest and roughest of sour orange trees, as although sour orange is not immune to Mal de Goma, it is highly resistant. After being washed in water to rid them of gum or mucilage, they should be broadcasted, without drying, on a seed bed which has been previously well forked and broken up. The seed bed should then be covered up with Banana and Heliconia leaves which should be left until the seeds have germinated. If the seeds are dried previous to sowing, there will be a large percentage of crooked rooted seedlings. Seeds from different trees give widely different stocks, some making much better growth than others. In some also the buds "come away" quicker and make more vigorous growth.

Nursery Beds.

When the seedlings have produced the first pair or two pairs of permanent leaves they should be lifted out of the ground without soil, and their tap roots cut if too long. All twisted rooted seedlings should then be discarded and the good ones planted firmly with a dibbler in the nursery beds.

Beds about three feet in width and about one foot above the surrounding ground level, of loose friable or sandy soil are the best, as sand helps the growth of deep rooted stocks. Beds of this size are easy of access to the men engaged in budding and transplanting. The small seedlings should be planted in two rows on the bed about one foot apart in the rows, where they remain till they are budded and ready to plant out. At this time all stocks not up to the average size in the bed should be pulled out and thrown away, and on no account budded, as a stunted or badly grown stock will never produce a good tree.

Budding.

It is very important that all budding should be done high, at not less than one foot and preferably at 18 inches from the ground. As the point of bud union is the weakest part of the tree low budding is necessary in Florida where the danger of frosts is always before the orchard grower, while this method also means easier protection by mulching or covering up. In the Tropics, however, where damp conditions prevail the danger spot must be removed as far as practically possible from the wet ground and possible floodings.

Further, only buds from trees of which the bearing capacity is known should be used.

The best time for budding is from February to May. After budding, as the grapefruit bud makes growth, the young plant should be tied to a stake and headed at about three to four feet. Branches should be encouraged at intervals and the formation of horquets or forks must, if possible, be prevented. A fork is always a weak point in a tree with a large crop of fruit as it may split at this point.

Transplanting.

The "bare root" system of transplanting has been adopted in preference to the "ball of dirt" or "pilan" system for the following reasons :—

1. By shaking up the soil of the nursery bed with a fork and then gently pulling and lifting the plant it can be got out with all its roots practically intact. Any broken roots should, of course, be clean cut with a knife. With a ball of dirt, the root area is very limited owing to its size.

2. It is a much quicker and cheaper method.

3. Transportation is much easier, as the plants can be wrapped up in a piece of wet bagging in bundles of twenty-five or more.

4. It is possible to see that the roots of the tree when being put into its permanent hole in the field are spread out properly and evenly, and any deformation caused by stones, &c., in the nursery bed rectified. Also, trees with roots badly curled just below ground can be rejected. Any young growth or immature leaves should be trimmed off at the time of lifting.

Failure of the bare root system of transplanting can generally be traced to the fact that the bundles were opened and the young trees exposed to the sun so that the roots were allowed to dry out for some time before and during planting, and also through insufficient ramming.

Method of Planting.

The method of planting has consisted in digging holes three feet by three feet and filling these up with rubbish which is allowed to settle for at least three months before putting the young plants in. The latter should preferably be planted on the top of the filled hole and earthed up to the required level at the collar of the tree with the dirt thoroughly rammed round the roots, the top or collar roots being just left exposed. By this method the young tree will rest on a slight mound and if the round ridging is carried out subsequent to the planting the mound will not be very marked. Planting high is extremely important as practical experience has shown that only trees which have been budded or planted low have been attacked by Mal de Goma. Suckers should also be prevented from growing below the bud and if present should be nipped off.

Use of Drains and Catch Crops.

At first drains on the plantation were dug 18 inches by 18 inches across the slopes and the dirt round ridged. It was noticed during the second year, however, that the trees were inclined to sink below the level of the surrounding ground and that they did not look healthy. The drains were then dug to a depth of two feet by two feet and as a marked improvement in the appearance of the trees was observed the practice was adopted and continued of putting in two-foot drains throughout the field between every row. The use of interplanted crops such as corn and bitter cassava was also dispensed with as they appeared to interfere with the proper growth of the trees which were inclined to become spindly and to lose their compactness.

Cultivation and Care of the Plantation.

No suitable cover or smother crop has been found which can be grown at an economical cost. The Bengal bean grows easily but it is almost impossible to prevent it covering the whole of the trees.

The system of "aroundiering" or weeding round the trees by hand as far as the spread of the branches three times a year has been adopted. In addition the remaining portion between the trees has been cutlassed in July and August and again at about the end of the year before the crop begins. After this operation the trees are mulched round with the cut grass which, however, should be removed from around the trees at the beginning of the rains. Failure to do this tends to increase dampness round the collar and trunk of the tree and also in time by rotting down, to raise the level of the soil.

Light instrument tillage with animals is out of the question owing to the present system of drainage. Once the tree has been headed and formed no trimming or pruning is done beyond cutting out any dry wood and occasionally a branch growing right up in the centre of the tree where it shuts out the light and air. The tools used are an ordinary hack saw, a pair of secateurs and a pocket pruning knife. All cuts are flush and must be dressed with crude oil or solignum.

No spraying as a routine measure has been carried out although lime sulphur spray with the idea of cleaning up the trees has been applied twice after the crop was over, and just before the blossoms came out. As a spray, Burgundy mixture, which is easy to make, has also been tried on a small scale with results that may justify its use in the future.

Manuring of the Trees.

When the trees first began to bear the fruit was inclined to be coarse, the rind being thick and corky at the neck. Manures were then applied, both pen and fertilisers being used. As pen manure appeared to increase the coarseness of the fruit, only fertilisers have been resorted to since 1925 and these have been applied to every tree close to the outside ring of the aroundier each year about March at the following rates :—

	Young trees.	*Bearing trees.*
Potassium sulphate	.8 lb.	2.5 lb.
Ammonium sulphate	1.6 lb.	2.0 lb.
Buc. phosphate	1.6 lb.	3.5 lb.
	4.0 lb. per tree	8.0 lb. per tree.

These amounts will be gradually increased as the bearing capacity of the trees increases. It is generally distributed in two applications. It will be noted that as the tree gets older it requires a lesser proportion of Am. Sulphate and a greater proportion of Potash. Also, it has been found that on this particular soil applications of Potash tend to give a larger number of better quality medium or small fruit.

Diseases.

A number of trees (21) have been attacked by Mal de Goma or "Foot Rot." In each case this has occurred on trees planted too deep and budded at less than eight inches. The trees have been successfully treated, when the disease was not too far advanced, by cutting out diseased bark, applying crude oil or solignum to the cut surface, removing earth from the collar leaving the crown roots exposed, and then inarching three or four healthy sour orange seedlings above

GRAPEFRUIT CULTIVATION IN TRINIDAD.

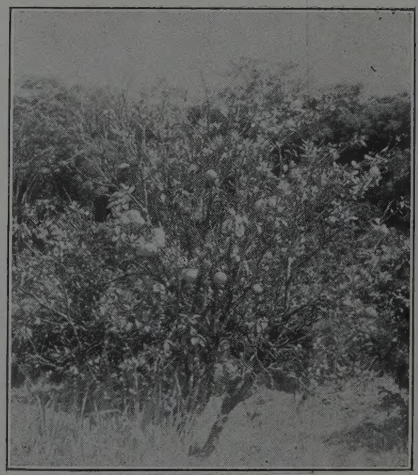
General view of plantation showing virgin forest in background.

In the plantation.

GRAPEFRUIT CULTIVATION IN TRINIDAD.

A typical six-year-old tree.

Showing method of inarching.



Tree attacked by mal de Gomma.

the affected area. This simple operation which provides the trees with fresh healthy roots can easily be taught to any intelligent overseer or driver and merely consists of planting three or four seedlings as close around the affected tree as possible. These seedlings should be stout and well grown and not less than two to three feet in height. As soon as they are well established, their tops are cut off with a sloping cut and bent in towards the tree in the bark of which an inverted T cut has been made, the tops being inserted under the bark and made fast by a small tack and budding tape. Union soon takes place. Trees inarched about a year ago and which at the time were on the point of dying have now recovered and are bearing fruit. A number of trees were found recently affected by Thread Blight, which can be controlled by spraying.

Insect Pests.

Little trouble was experienced from scale insects, but during the first two or three years Black Bees ate the bark and in some cases the young shoots or tips of branches of trees. The bees can best be kept in check by destroying their nests and by painting the trunks and larger branches with whitewash in which arsenite of lead was dissolved.

Parasol ants or Bachack, are always a severe menace as they will strip a tree in one day or night, and, if the tree is very young it will take six months or more to recover, if at all. Two cents a nest, whatever the size, is paid to any labourer who reports it to the overseer.

Picking of the Fruit.

This is a very important operation, as the fruit should be handled as carefully as possible. All fruit must be hand picked with special picking secateurs which cut the stalk close without injury to the fruit. No stalk projecting from the star should be left as the slightest projection will damage other fruit if it comes into contact with them. The star must not be taken off as this leaves open an easy way for rot to enter. As the fruit is picked, the picker places it in a bag (suspended round his neck and shoulders) which when full, can be opened at the bottom to allow the fruit to escape into the field boxes. Ladders, of course, must be used for fruit out of reach from the ground. The field boxes are then carried to the shed awaiting transport to the Central Packing Shed or packed on the estate.

Crop Returns, Packing and Disposal of Fruit.

The following figures represent the crop returns from 600 trees planted in the years 1921-1923, the majority of which were planted in 1923 :—

Year.	*No. of fruit picked.*
1925	565 fruit.
1926	10,121 do.
1927	67,525 do.
1928	8,000 do.
1929	42,068 do.
1930	114,322 do.

The large fall in the production of fruit which is reflected in the production figures for 1928 was due to flat forking the trees up to the spread of the branches the year before, an experiment which proved disastrous.

Most of the packing has been done in a small shed originally built for storing the field boxes. This shed has provided sufficient space, however, to wash, dry, size, grade and pack more than 100 cases per day. In practice, this meant only 100 cases per week as the fruit requires quailing for several days after picking. In 1930 it was possible to pack and ship over 1,269 cases which accounted for about 85,000 fruit. Since 1929 most of the fruit has been exported to Canada, Liverpool and London, and Bermuda, where it found ready sale and was favourably commented upon.

GINGER.

THERE is a large production of ginger throughout the Empire, India, British Malaya, Sierra Leone, and Jamaica being the chief producing countries. Consumption of this spice in the United Kingdom, however, shows a marked decline as compared with two years ago. During 1929 imports amounted to 24,104 cwt., valued at £96,029 as against 21,767 cwt., valued at £83,088, in the previous year. Ginger is the root of the plant *Zingiber officinale*, and is a popular flavouring agent.

India is one of the world's largest producers of ginger, and during last year it was able to export 37,580 cwt. (Rs. 15,07,435). In 1928 shipments of ginger from India amounted to 36,653 cwt., valued at Rs. 14,24,122.

In British West Africa ginger is grown in Sierra Leone and Nigeria, especially in the former colony. Efforts have been made of late to market an improved quality, and judging by export figures this has already led to better business, for last year the quantity of ginger exported from Sierra Leone amounted to 30,966 cwt. (£59,308), which was more than 10,000 cwt. above the amount shipped in 1928.

If the quality of ginger now grown on a small scale in Nigeria improves, an export trade of considerable value to that colony should also develop.

In the British West Indies, Jamaica is a well-known producer of ginger. Its quality is exceptionally good, and is in world wide favour. Exports for last year amounted to 2,128,876 lb., as compared with 2,370,121 lb. in 1928. The islands of Dominica, St. Vincent, and Trinidad also grow this spice for export, Dominica doing the largest trade, and last year shipping 8,475 lb.

Ginger grows well in British Malaya, which produces sufficient to satisfy home requirements and a fair export demand.—(*The Chamber of Commerce Journal*, Vol. LX, No. 858.)

FUSARIUM CUBENSE.

(1) Fusarium Cubense, E.F. Sm., An Examination of Five Strains.

By C. W. Wardlaw.

1. Introduction.

Fusarium cubense, the causal organism of Banana Wilt (Panama Disease), has already received considerable attention at the hands of mycologists. Its frequent isolation has brought many cultures to hand which, though pathogenic, are by no means uniform in their morphological and physiological characters. Thus Brandes (2) remarks on the considerable variation which he observed in his cultures and mentions that two sub-cultures from a single-spore parent strain will vary somewhat under apparently identical conditions. Reinking (7) also noticed the presence of different strains in his isolations of *Fusarium cubense*. The work of Hansford (6), however, placed the problem on a much wider basis. During the course of his investigations some three hundred strains of the sections *Elegans* were isolated. Of these, one hundred were obtained from the vascular bundles of plants suffering from Panama Disease. These strains, subsequently re-cultured from single conidia, he classified into five groups, according to the size, shape and septation of conidia, production of sporodochia or pionnotes, and presence or absence of sclerotia. A number of strains selected from these groups were found by inoculation experiments to be pathogenic to the Gros Michel banana, producing the typical Panama Disease symptoms. From the uniformity of this result he concluded that the members of these five groups must be included under *Fusarium cubense* E.F. Sm. But in addition to the strains isolated from the vascular tissues of bananas suffering from Panama Disease, Hansford isolated a collection of 212 strains from various sources, soil, plant debris, &c., which also belonged to the section *Elegans*. These were classified into five groups, more or less corresponding to the previous five, the important difference being their non-pathogenicity to the Gros Michel. More recently Ward (8) has described two types of Panama Disease from Malaya, to wit, an acute and a chronic form, while as regards the causal organism he observes that at least four different physiological strains of *Fusaria* belonging to the *Elegans* section are pathogenic to the banana. On both virgin and cultivated land he isolated a *Fusarium* species morphologically similar to *F. cubense* isolated from Panama Disease cases.

Such observations raise many important questions regarding the distribution of pathogenic strains of *Fusarium cubense* in tropical soils, virgin or cultivated. On the subject of strains and on the question of their relative pathogenicity much remains to be done, whilst the origin of new strains by saltation deserves careful investigation. While neither Reinking nor Hansford mentions the occurrence of saltations in their cultures, it seems reasonable, since a large number of closely related strains of *Fusarium cubense* are in existence, to expect that given the necessary cultural conditions, some evidence of this phenomenon might be obtained. In point of fact, the occurrence of saltation is indicated by Brandes' observations, while at an early stage in the present work sectoring occurred in cultures grown from single hyphal tips, and definite saltants were obtained.

Since most of the previous work on *F. cubense* is based on relatively unstandardised media such as potato blocks, banana peel, stems, &c.—a more intensive investigation seemed desirable. This paper, therefore, is a record of an analysis of the different characters shown by several selected strains when grown on standard culture media.

The data recorded here are intended to prepare the way for further investigation. So far *Fusarium cubense* has been isolated in many different countries and from several different varieties of banana. For pathologists the fundamental question underlying this investigation is: do the several isolations from different sources all show the same degree of pathogenicity? To answer this question it will first of all be necessary to work out a suitable inoculation technique so that disease effects can be produced quickly and accurately compared.

2. Selection of Strains.

Preliminary to a more detailed investigation, cultures from the writer's collection of some three dozen isolations of *Fusarium cubense* were first of all re-cultured from single hyphal tips (3). These were then grown for general observation on (*a*) Brown's Standard Medium (4), (*b*) ground rice agar, (*c*) soil extract agar, (*d*) Richard's solution agar, (*e*) potato saccharose agar, (*f*) steamed rice and (*g*) potato blocks. After several days external differences were readily observed in (I) rate of growth, (II) nature of the mycelium and sporulation and (III) colour production. In fact from the collection of cultures graded series could be arranged regarding each of these characters.

The following five strains were selected for more detailed investigation :—

Strain B.—From Reinking's strain No. 15, proved to be pathogenic to the Gros Michel in Central America.

Strain C.—From a culture in the collection of the Imperial College of Tropical Agriculture, Trinidad.

Strain D.—From the C.B., Holland.

STRAIN E.—From the C.B., Holland. This is a culture of *F. Oxysporum*, and is included in these studies because of the over-lapping of *F. cubense* and this species in their general characters.

STRAIN F.—From a culture isolated by the writer in Trinidad in 1928 from the Gros Michel, and proved pathogenic.

STRAIN G.—From a culture isolated by the writer in Trinidad in 1928, and proved pathogenic.

3.—Growth of Standard Medium.

The six strains were first of all grown on Brown's (4) Standard Medium, of composition :

Glucose	2.00 grammes.
Asparagin	2.00 do.
K_3PO_4	1.25 do.
$MgSO_4$	.75 do.
Agar	15.00 do.
Water	1000 ccs.

The above, which contains the essential constituents of potato agar, was selected as a standard medium.

As indicated in Table 1 (average measurements from six plates of each) the strains show slight but consistent differences in the rate of growth as measured by increase in colony diameter in petri-dish culture.

TABLE 1.
AMOUNT OF GROWTH AT THE END OF SEVEN DAYS, IN CMS. (TEMP. 78-82°F.)

Strain B	7·4
Strain C	6·7
Strain D	6·9
Strain E	7·0
Strain F	8·0
Strain G	7·4

Marked differences were noted in the general appearance of the six cultures. These may be summarised as follows, reference being made to growth in both light and darkness at the end of seven days.

Strain B.—Dense white aerial mycelium right to the edge of the colony, with spore rings corresponding to the number of days of growth. The edge of each spore ring lies slightly behind the maximum point of growth reached each day; owing to the density of the aerial mycelium they can only be seen by holding the culture against the light. In the dark no spore rings are present.

Strain C.—In the light the culture shows a very slight development of aerial mycelium, the major portion of the mycelium being submerged. The aerial mycelium tends to disappear in patches. A very slightly developed spore ring may be present near the centre. In the dark the colourless mycelium is completely non-aerial, except for a slight trace at the centre where a suggestion of spore rings may also be present.

Strain D.—In both light and darkness the cultures are practically uniform, the mycelium being colourless and completely submerged or non-aerial. A very slight spore ring may be present near the central inoculum. A considerable amount of culturing showed that the only megascopic difference between *Strains C* and *D* on the standard medium lies in the fact that while *C* may give a slight aerial mycelium in the light, *D* never does.

Strain E. (F. Oxysporum).—In the light a strong aerial mycelium, somewhat less dense than *B*, is developed right to the edge of the colony. Spore rings are feebly defined or absent. In the dark the aerial mycelium is less plentiful and spore rings are absent.

Strain F.—In the light the whole colony has a pale salmon colour, with ill-defined spore rings. Yellow to salmon spore masses occur in the vicinity of the inoculum. In the dark the colony has a pale salmon to pale pink colour. The mycelium might be described as slightly aerial in the light and practically non-aerial in the dark.

Strain G.—In the light the dense aerial mycelium is almost as strongly developed as that of *B*, and is present to the edge of the colony. The culture as a whole may develop a slight pinkish colour, with well defined, coloured spore rings. In the dark the aerial mycelium is a little less dense, with a slight spore ring round the inoculum.

Distinct differences and similarities in the several strains thus become apparent when grown on the standard synthetic medium. Thus B and G may be taken as examples of the dense aerial white mycelial type, C and D of the submerged type, while F and E occupy intermediate positions. When the entire collection of cultures was grown on this medium, practically every gradation from the non-aerial to the dense aerial mycelial type was observed. Again, the cultures may show slight traces of colour from pink to salmon, or the mycelium may be pure white. *Strain F* is an example of a well marked coloured type.

4. Growth on Richard's Solution Agar.

When grown in petri-dishes of Richard's solution agar * in the light at room temperature (78-82°F) the cultural characters set out in Table 2 were observed at the end of 23 days.

Richard's solution agar thus brings out prominently further megascopic differences, namely the power of some strains to warp the colony into undulations or strongly marked involutions. This character is not necessarily associated with the amount of mycelium. Shallow plates of medium did not show the characteristic warping of the colony. Colour differences were also revealed by the use of this medium.

* Richard's solution agar: Cane sugar, 50 gms.; KNO_3, 10 gms.; KH_2PO_4, 5 gms.; $MgSO_4$, 2.5 gms.; Agar, 15 gms.; Water, 1,000 ccs.

TABLE 2.

CULTURAL CHARACTERS ON RICHARD'S SOLUTION AGAR.

Strain.	Colour.	Appearance of Colony.
B	Pale salmon-pink	Dense aerial mycelium with tussocks or undulations.
C	Pale ochre	Uniform even mycelium, very slightly aerial.
D	Medium ochre	Uniform even mycelium, slightly aerial.
E	White	Aerial mycelium ; colony thrown into undulations, with autolysed patches.
F	Pink to salmon	Slight aerial mycelium ; colony thrown into brain-like corrugations.
G	Pinkish white	Uniform dense aerial mycelium with small tussocks or undulations.

5. Growth and Colour Production on Rice Media.

The capacity of members of the section *Elegans* to produce colour when grown on rice media is well known. The characteristic colour produced by *F. cubense* has been described by Ashby (1) as Claret red or blood red, by Brandes (2) as a delicate Hemosa pink which deepens to spectrum red and violet purple, while Reinking (7) describes the first colour as varying from thulite pink to spinel pink and spinel red, and the colour of the older cultures as spinel red to Indian lake.

In order to test the colour reactions of the six cultures, each was first of all inoculated into tubes of steamed whole rice. When examined at the end of fourteen days all showed characteristic pink colourations and while it was evident that differences were present, the substratum was not of such a nature as to make them conspicuous. To carry out a more detailed examination of the colour reactions three media containing different concentrations of ground rice were prepared as follows :

Medium 1—12 grammes ground rice
Do. 2— 4 do.
Do. 3— 1 do.
} + 3 gms. agar and 200 ccs. water.

These were plated out and inoculated with the six cultures. The colour reactions obtained are shown in Table 3, the intensity of colour produced being indicated by numbers. Pink colour just definitely perceptible is indicated by 1, and greater intensities by higher numbers, the number for each culture being gauged by a general comparison. The greatest intensity thus obtained is indicated by 6, the lowest by 1.

TABLE 3.

Age of culture in days.	B medium 1 2 3	C medium 1 2 3	D medium 1 2 3	E medium 1 2 3	F medium 1 2 3	G medium 1 2 3
2	1 - -	2 1 -	2 1 -	- - -	1 - -	1 - -
5	2 1 -	4 3 -	4 3 -	2 1 -	3 2 -	2 1 -
9	3 3 -	6 5 1	5 4 -	5 2 -	3 2 -	2 2 -

Descriptions of strains on medium 1.

Strain B.—Reddish purple in medium masked by the presence of an abundant aerial mycelium.

Strain C.—Strong purple with no aerial mycelium.

Strain D.—Strong purple with no aerial mycelium.

Strain E.—Bluish purple, masked by strong aerial mycelium.

Strain F.—Salmon purple, moderate aerial mycelium.

Strain G.—Purple, masked by abundant aerial mycelium.

It will be seen that the greatest amount of colour is produced by strains C and D both being of the type with submerged mycelium. The pinkish colours usually obtained with whole rice grains tend to be replaced by more purplish shades when fine rice particles are incorporated in an agar medium.

6. Growth at Different Concentrations of the Standard Medium.

None of the selected strains is of the staling type when grown on the normal standard medium (N). Staling could be induced in some of the strains, however, at higher concentrations.

When cultured on 4N, 2N, N, $\frac{N}{2}$, $\frac{N}{4}$, $\frac{N}{8}$ concentrations, *Strain B*, showed the greatest amount of staling, while *Strain F* showed none even at the concentration of 4N. Strains C, D and G occupied an intermediate position between B and F.

External Characters of Cultures.

Strain B.—It has already been seen that on the standard medium of normal concentration this strain produces a dense white aerial mycelium with spore rings. Increased concentration of the medium leads to an increase in the density of the aerial mycelium. This experiment therefore produced a graded series from the dense aerial to the submerged type of mycelium, the transition from aerial to non-aerial taking place in the vicinity of $\frac{N}{2}$. At $\frac{N}{4}$ a very scanty aerial mycelium was found and at $\frac{N}{8}$ none. Spore rings also were absent at concentrations lower than $\frac{N}{2}$.

Strain C.—At $\frac{N}{1}$ concentration of the standard medium this strain has a scanty development of aerial mycelium. At 4N aerial mycelium is present in moderate amount, is less at 2N, scanty at N and disappears at lower concentrations, where even the submerged mycelium is scanty. *Strain D* behaves in a similar manner.

Strain F.—Here the changes in the amount of aerial mycelium developed are not so obvious, though again the greatest development is at the higher concentrations. The pinkish colour characteristic of this strain is also considerably increased at 2N and 4N.

Strain G.—This strain behaved in practically the same manner as strain B.

7. Growth on Potato Blocks.

Reinking's general description of the growth of *Fusarium cubense* on potato tuber blocks shows that considerable variation in colour and mycelial development may be expected on this medium. As it is a highly unstandardised and variable substratum it is rather unsuitable for a detailed comparison of strains. In order to bring these observations into line with those of other workers, however, it has been found convenient to make use of this medium for certain purposes, notably for the development of sclerotia.

Each of the six strains was accordingly grown on potato blocks in test tubes and examined after 11, 19 and 39 days. The observations based on two cultures of each strain are summarised in Table 4.

TABLE 4.

CULTURAL FEATURES ON POTATO BLOCKS.

Culture.	Nature of Mycelium.	Colour.	Sclerotia at the end of 39 days.
B	Abundant aerial	Pale salmon	Small sclerotia, close to potato block, completely obscured by mycelium.
C	Moderate aerial	Pale purple to pale salmon, bluish purple on glass	None.
D	Moderate aerial, but less than C	Pale purple with salmon in small areas.	None.
E	Adhering closely to substratum No fluffy aerial hyphae	Moderately deep heliotrope	None.
F	Adhering closely to substratum	Salmon to purple, bluish-colour developed on substratum	A few large wart-like sclerotia.
G	Abundant aerial	Pale salmon	Conspicuous dark blue sclerotia.

On the whole, while potato block is useful for determining the presence or absence of sclerotia, its variable composition militates against the accuracy with which other characters can be compared. In the above experiment, for example, the two tubes of each strain were by no means strictly comparable throughout.

8. Sporulation.

The sporulation of *Fusarium cubense* has been described by various workers from cultures grown on natural media such as potato block, potato agar, banana peel, bean pod, &c. By using all of these media the sporulating capacity of any one strain can be followed out very completely, *i.e.*, while some media may produce only non-septate or one-septate conidia others allow of the production of a higher degree of septation. In the present work a final account of the sporulating capacity of the six strains has not been attempted. The object rather has been to compare their sporulation when grown under uniform conditions on a standard medium. A synthetic medium formulated by Brown (4) of the following composition was used :—

Glucose	2.0	gms.
Potato Starch	10.0	,,
Asparagin	0.2	,,
K_3PO_4	1.25	,,
$MgSO_4$	0.75	,,
Agar	15.00	,,
Water	1,000	ccs.

This is a variation of the standard potato medium in which the carbohydrate content is increased and the nitrogen content reduced. Sporulation was examined after 15 days, the mycelial samples being taken uniformly at a distance of about 1 cm. from the central inoculum. The percentage sporulation is set out in Table 5, and spore measurements in Table 6. (Owing to the relatively short period allowed for spore development the figures submitted in Table 5 under *0-Septate* may in some instances be slightly high because of the inclusion of immature septate conidia.)

TABLE 5.

SPORULATION ON STANDARD MEDIUM (PER CENT.).

Culture.	0-Septate.	1-Septate.	2-Septate.	3-Septate.
B	89	6	1	4
C	99	1	—	—
D	99	1	—	—
E	98	2	—	—
F	91·5	6	2	0·5
G	25	12	3	60

TABLE 6.

Culture.	0-Septate.	1-Septate.	2-Septate.	3-Septate.	4-Septate.	Chlamydospores.
B	3.5-16.5	15.0-25.0	25.0-30.0	30.0-35.0	40.0	None.
C	4.0-15.0	15.0-21.0	21.0-25.0	—	—	Chlamydospores very abundant.
D	3.5-15.0	13.5-20.0	20.0-25.0	—	—	Chlamydospores very abundant.
E	4.0-16.5	12.5-17.5	16.5-24.5	25.0-35.0	—	Chlamydospores abundant.
F	5.0-17.0	15.0-21.5	20.0-25.0	25.0-35.0	—	Chlamydospores just forming.
G	5.0-12.5	12.0-21.0	21.0-25.5	26.0-40.0	38.0-45.0	Chlamydospores just forming.

It will be seen that the six strains show important differences in the degree of septation. In B, C, D, E and F non-septate spores predominate, whereas in G three-septate spores are in the majority. In the *strains C* and *D* the numerous chlamydospores were the outstanding feature of the cultures, whereas they were absent in *strain B* and were just forming in *strains F* and *G*. *Strain E* forms chlamydospores abundantly; they differ from those of *strains C* and *D* in their corrugated outer

TABLE 7.

SPORULATION OF STRAIN G AT DIFFERENT CONCENTRATIONS OF THE STANDARD MEDIUM.

Concentration of Medium.	Size of Spores, per cent. sporulation.	0-Septate.	1-Septate.	2-Septate.	3-Septate.	4-Septate.	5-Septate.	Average Septation.	Remarks.
4 N	Size (μ)	4.0-21.0	16.0-22.5	21.5-25.0	26.0-30.0	—	—	—	No chlamydospores; sporulation not profuse. Conidia swollen and constricted at septa; highly vacuolated.
	Per cent. sporulation	97.0	2.5	0.4	0.1	—	—	0.03	
2 N	Size (μ)	4.0-22.5	12.5-20.0	20.0-33.5	22.5-37.5	35.0	42.5	—	Chlamydospores just forming. Sporulation not profuse. Constrictions still present, but not so marked.
	Per cent. sporulation	87.0	8.0	2.0	3.0	—	—	0.21	
N	Size (μ)	4.5-22.0	12.5-22.0	20.0-30	27.5-42.5	35.0-42.5	42.5	—	Chlamydospores being formed; sporulation more abundant; no constrictions.
	Per cent. sporulation	83.1	6.0	1.3	9.6	—	—	0.37	
N/2	Size (μ)	4.0-21.0	12.0-27.5	20.0-30.0	25.0-40	45.0	—	—	Chlamydospores being formed. Conidia more slender.
	Per cent. sporulation	79.0	6.0	4.0	10.0	1.0	—	0.48	
N/4	Size (μ)	3.5-21.0	12.5-23.0	21.5-27.5	30.4-40.0	42.0	42.0	—	Chlamydospores just forming. Conidia slender and attenuated.
	Per cent. sporulation	76.0	4.5	2.5	16.0	1.0	—	0.60	
N/8	Size (μ)	3.5-20.0	12.0-23.5	22.0-27.5	32.5-37.5	—	—	—	Conidia slender, attenuated.
	Per cent. sporulation	89	3	2	6	—	—	0.25	

The percentages in the 0-Septate column are probably slightly high on account of the inclusion of some septate conidia which are still in an immature state. Material taken from spore rings contains much higher percentages of septate conidia.

wall. While no attempt will be made in the present work to classify these strains it may be mentioned that Hansford's classification includes groups of high and low septation in which these strains could be placed. By reference to Table 6, it will be seen that the spore measurements show close uniformity throughout. As far as could be determined after the growth period of 15 days, the shapes of the spores of the six strains, with a few exceptions, were comparable. *Strain E* (*F. oxysporum*) could be distinguished by its corrugated chlamydospores and also by the rounded turgid appearance of the conidia, a character which was also noticeable in *Strain F*, where constrictions at the septa were frequent; the latter culture also showed spores which had germinated *in situ*. Thus while the six strains are distinguished by important differences in the degree of septation, their conidia show considerable uniformity in both shape and size. The data submitted do not, of course, refer to the maximum sporulating capacity of any of the strains. An examination of older cultures reveals a higher degree of septation.

9. Sporulation at Different Concentrations of the Standard Medium.

Sporulation of the cultures described in Section 6 grown at different concentrations of the standard medium was next examined. On account of the low degree of septation of *strains* B, C, D, E and F at normal concentrations only *strain* G provides favourable material for these observations. The results set out in Table 7, indicate that *strain G* shows the same general reactions as the strains of *Fusarium* described in detail by Brown and Horne (5), *i.e.*, that concentration of the medium reduces the degree of septation while dilution increases it. The spores also exhibited constrictions at the septa at the higher concentrations. An examination of *strain B* and *strain F* gave similar results but the normal low septation of these cultures makes them rather unfavourable material for this examination. The data submitted regarding *strain G* as also those made on the other selected strains show how necessary it is in this group to work with standard media and uniform conditions if an accurate comparison or classification is to be obtained.

10. Discussion.

By growing strains of *F. cubense* on a variety of standard media under uniform conditions a number of important differences become apparent. These include (1) rate of growth, (2) nature of the mycelium, aerial or submerged, (3) colour of the mycelium on Brown's standard medium and Richard's solution agar, (4) power of the fungus to distort the latter medium into undulations or corrugations, (5) extent of colour reactions on rice media, (6) presence or absence of staling at high concentrations of the standard medium, (7) presence of sclerotia, (8) rate of formation of sclerotia, (9) presence of chlamydospores and rate of formation, (10) nature of sporulation, and (11) odour produced on rice media. Doubtless by the use of other media additional characters would also come to light. Of the five strains examined no two are exactly alike. The *strains B* and *G* have many points of resemblance in their general cultural characters but differ markedly in their sporulation and formation of sclerotia. For convenience their several characters have been compared in Table 8. *Strains C* and *D* are very similar but differ slightly in their colour reactions on rice media and in the amount of aerial mycelium produced on the standard medium. *F. oxysporum* (strain E) occupies a more or less central position, but a valid comparison would have to take into consideration other strains of this species also.

Now the five strains of *F. cubense*, as also the larger collections from which they were selected, represent separate isolations from banana plants suffering from Wilt or Panama Disease. Using sporulation as the basis for classification strains B, C, D and F would fall into one distinct group and G into another, while using chlamydospores

TABLE 8.

COMPARISON OF THE CULTURAL FEATURES OF STRAINS B AND G.

	STRAIN B.	STRAIN G.
Origin.	Honduras	Trinidad.
Amount of growth on standard medium in cms. (7 days.)	7.4	7.4
Appearance on standard medium	Dense white aerial mycelium to edge of colony, with well developed spore rings.	Dense white aerial mycelium to edge of colony, with well developed spore rings.
Richard's solution Agar	Dense white aerial mycelium with tussocks or undulations.	Dense aerial mycelium with small tussocks or undulations.
Rice Agar	Reddish purple, masked by aerial mycelium	Purple masked by aerial mycelium.
Potato block (*a*) appearance of mycelium, (*b*) sclerotia	Pale salmon, abundant aerial; small sclerotia masked by hyphae.	Pale salmon, abundant aerial; conspicuous dark blue sclerotia.
Sporulation	0-Septate 89 per cent. 3-Septate 4 do.	25 per cent. 60 do.

C and D would make one group, F and G another and B yet another and so on. On the other hand by using a concensus of the megascopic vegetative characters which appear on standard media, B and G would constitute one group, C and D another, while F would stand apart. The findings from the detailed analysis of the five selected strains were also borne out when a comparative examination of the final collection of isolations, some sixty in all, was made. A striking range of variation was shown by the different strains, and when the basis of comparison was extended by using a sufficient number of different culture media, a rigid grouping was found to be impossible if all the cultural characteristics were taken into consideration. What is true of *F. cubense* is probably true also to some extent of the other species included in the *Elegans* section. Such observations indicate the difficulties with which any attempt at a natural classification will remain beset until the pathogenicity as well as the morphology of this group is more fully investigated.

11. Summary.

1. An account is given of the cultural characters of five selected strains of *Fusarium cubense* and one strain of *F. oxysporum* when grown on standard media.

2. The five strains show important differences in vegetative growth, production of colour, formation of chlamydospores and sclerotia, and nature of sporulation.

3. The relation of these variable characters to classification is briefly discussed.

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SULTAN IDRIS COLLEGE.

Agricultural Vernacular Education in the Federated Malay States.

By T. H. Nicoll, M.A., B.Sc.

Introductory.

The subject of Agriculture (Ilmu Tanaman) forms a most important part of all native education especially in a country such as Malaya, in which the soil contributes so largely to the national income. One of the most outstanding educational problems of the present age, is how to educate the native in such a manner that he does not look on manual labour, which is an essential in an agricultural community, as degrading. The mechanical age quickly gets its hold on the native mind inducing him to leave his natural habitat to look for success in other spheres, which so often prove failures. A transition stage is always dangerous and vernacular education is no exception.

The College.

The Sultan Idris Training College, a large residential College founded and controlled by Government and modelled on the lines of an English public school, trains Malay pupil teachers for service as school masters in the Malay vernacular schools, and forms Malaya's sole source of supply in this respect. It is situated at Tanjong Malim, Perak, a rural area and is over fifty miles from the nearest large town. This is considered important as affecting the mental outlook of the students. The College course is of three years duration; there are 390 students, 130 to each year divided into fifteen classes each of about 26.

The aim of the Malay vernacular schools as defined by the Government in 1920 "is not to turn out a few well-educated youths nor yet numbers of less well-educated boys; rather it is to improve the bulk of the people and to make the son of the fisherman or peasant a more intelligent fisherman or peasant than his father had been, and a man whose education will enable him to understand how his own lot in life fits in with the scheme of life around him." The great majority of the indigenous population of Malaya is engaged in agriculture, so that it has long been considered necessary for Malayan vernacular education to have an "agricultural bias."

Syllabus.

It is with a view to keeping these problems in mind, that the Syllabus of the Sultan Idris College is compounded, and that School Gardening with Rural Husbandry plays such a large part in that Curriculum, both theoretical and practical. Rural Husbandry has necessarily a fairly wide scope and embraces at least a superficial knowledge of all the principal sciences. The method of instruction is that in which the student will derive most benefit and advantage, when he either takes up his post as a native teacher, or returns to his own village. Thus Rural Husbandry together with School or "Plot" Gardening form the basis of that Curriculum.

The College Course occupies three years, each one consisting of two terms, and at the end of that time, if the student has proved himself successful in the annual examinations, together with his daily class and practical work he is awarded the College Diploma, either 1st, 2nd, or 3rd Class according to merit. A brief resumé of the Gardening Course will serve to show the manner in which the subject is divided into the three years, and though perhaps capable of improvement, is eminently practicable and gives fairly satisfactory results. Every endeavour is made to present the subject to the boys in as attractive and palatable a manner as possible, and to prove to them the practical advantages of work on the soil, for there is no surer road to prosperity and success than along these lines.

First Year Course.

The First Year introduces the students to soils in all their complexities and activities.

Various methods of soil improvement are fully discussed and practical demonstrations given in outdoor work. At the same time, the relation of plants to the soil, their elementary structure, food materials and means of absorption of that food, are explained as simply as possible. Apart from explaining the cellular construction of plants and discussing their outward form, it has been found best to leave the study of the real Botany of the plant till the Second Year, when the student's mind has, at least, to some extent, been trained to think on scientific lines. The First Year is the nursery stage and consequently requires special care on the part of the teacher, if he wishes to reap the fruits of his labour at the end of the Course. It is at this stage, more than any other, that care is necessary to prevent the student from missing any of the essential points, for it is on this foundation, that all the rest of his facts have to be built. Diagrammatic work on the black-board is largely indulged in and a written test of the work done held every two months.

On the practical side, in the first and second years, each student has an individual plot, divided into three ridges (*see* card indices) which he has to look after himself, with the advice of the staff. Four mornings per week from 6.30 to 7.30 a.m.

Specimen Card Indices.

(*In English and translated into Native Language.*)

NAME. ..... **CLASS.** ..... **PLOT No.** .....

Ridge I.			Ridge II.			Ridge III.		
CROP.			CROP.			CROP.		
Date of Manuring and weight of manure.	Date and distance of planting.	Date of harvesting and weight of crop harvested.	Date of manuring and weight of manure.	Date and distance of planting.	Date of harvesting and weight of crop harvested.	Date of manuring and weight of manure.	Date and distance of planting.	Date of harvesting and weight of crop harvested.

NAMA. ..... **CLASS.** ..... **PLOT No.** .....

Batas I.			Batas II.			Batas III.		
JĒNIS.			JĒNIS.			JĒNIS.		
Hari bulan baja dan bērat-nya.	Hari bulan tanam dan jarak-nya.	Hari bulan masak dan bērat hasil-nya.	Hari bulan baja dan bērat-nya.	Hari bulan tanam dan jarak-nya.	Hari bulan masak dan bērat hasil-nya.	Hari bulan baja dan bērat-nya.	Hari bulan tanam dan jarak-nya.	Hari bulan masak dan bērat hasil-nya.

and one afternoon from 4.45 to 6 p.m. are devoted to this outdoor work. On each of his three ridges he plants a different crop and as he has at least two lots per year, it gives him a general knowledge about the growth and habit of six different crops. Each boy has a notebook in which all that he does each day in his plot is entered, and later transferred to the card index. This gives him some experience in recording work. Each month, marks are awarded for the plots, when consideration is taken of the condition of the crops grown, tidiness, amount of care expended, &c., &c.

Second Year Course.

In the second year the individual plot system of outdoor work is continued, but as far as possible a different series of crops is grown. At the same time, each student has one large tree under his special care, which may be either a fruit or ornamental tree in the College Grounds. He is responsible for keeping that tree in the healthiest possible state and should any disease be discovered, the matter is immediately reported to a master or one of the third year students who instructs him how best to combat the disease. If it is a disease not so far described to the students, they gather round the specific tree and a short lecture is given about it. It is found in this way that the boys gain a fair knowledge of the common trees of their native land, the diseases to which they are subject, and the best means of disease prevention and control. At the same time it gives them a certain amount of interest in the upkeep of their own College Grounds, and prepares them for further work on these lines which they have to undertake in their third year.

On the theoretical side, the term commences with a thorough study of Plant Physiology and Anatomy with practical work. Though no laboratory work is possible, each student is supplied with a specimen of the plant or part of the plant, about which the lesson is being given. Free use is made of diagrammatic work on the blackboard both by masters and students. Also whenever possible, sections are cut and demonstrated under the microscope to each student in each class. In time it is hoped that the students will be able to undertake a little microscopic work on their own.

When the student has thoroughly grasped the functions of the various plant organs, the various methods of plant propagation are studied and here again practical example plays an important part. The College has its own nurseries for which the boys are responsible, under European supervision. Also demonstration and actual practice is given in reproduction by layering, suckers, grafting, budding and cuttings.

A study of the best and most up-to-date planting methods for garden crops is made and in turn carried out by the boys on their individual plots. Efforts are made to impress on them how much the future life of the plant depends on the care expended on its planting and seedling stage. This is one of the educational lines which has shown the best results, as the standard of crops grown in the plots is now very high. If the same results could only be obtained in the villages, native prosperity and happiness would then be distinctly on the upgrade. There is no better way of bringing this to pass than the training at the College, because the majority of the students ultimately become teachers in the vernacular schools, and in Malaya, like all other countries, advancement is best obtained through the young.

The term concludes with a study of animals and their relation to plants. As full notes as possible are given on animal husbandry, particular attention being paid to animal nutrition and it is hoped in the near future that it will be possible to demonstrate actual feeding experiments at the College itself.

Third Year Course.

The third year course is essentially a practical one and devoted to putting theory taught in the previous years into practice. The students are given actual practice in teaching in the vernacular school which is attached to the College. Then, in their outdoor work, the individual plot system is dispensed with and various other outdoor activities undertaken. In each year there are five classes, A, B, C, D and E, so that five different types of work are allotted. Each class undertakes one and every three weeks a change over is made, till every third year student has partaken of each type. About one term is necessary to complete the rotation of these duties and in the second term it is hoped to try and allot the other five schemes of work, so that at the end of the year students will have had experience of the different types of work. The scheme at present in use, is as follows :—

A.—Care of orchard, planting of new fruit trees, pruning and manuring where necessary.

B.—Care of nurseries and large communal plots. This includes sowing of seed, care of seedlings, transplanting, thinning out, &c. Also practice in care and harvesting of a fairly large variety of crops. The communal plots include Maize, Lima Bean, Ground Nut, Tomato, Lettuce, Long Bean, French Bean, Sweet Potato, &c.

C.—Care of the ground under economic crops. At present this only includes pineapples, tea and coffee, but it is hoped to extend the scope in future. This gives considerable practice in disease control and cultivation methods.

D.—Supervision of the plots of first and second year students, with advice and help to them where necessary.

E.—Ornamental work and care of flowers in College Grounds. This includes experience in the laying-out of flower beds and general decoration and improvement of gardens.

This departure from the individual plot system in the third year to general work, is a new innovation but as far as it is possible to judge it is proving very successful. Another innovation which it is hoped to try out, is to select a few

students who exhibit any particular aptitude for gardening work and give them a few simple agricultural experiments to carry out, *e.g.*, spacing experiments, variety yields, &c.

The theoretical work includes a course in plant and animal pests and diseases, a thorough study being made of the diseases and of the common and practicable methods of control. As far as possible the students are trained to apply these simple and every-day methods in their work in the gardens. It is felt that if once the student grasps the full significance of disease in its early stages and knows the essentially practicable way of dealing with it, that he will be able to apply these general principles to any crop in any place he may be stationed. Every effort is made to avoid and to prevent mere memorisation of facts. Later in the term the major economic crops of Malaya—Rubber, Coconuts, Rice, &c., come under review, here again simple and practical measures alone are adopted and emphasised. Short talks also dealing with the aspects of economics which particularly affect Agriculture, *e.g.*, Marketing, Co-operation and Costs of Production are included in the course of study and explained as simply as possible. Finally, as the students are being trained for appointments as teachers in vernacular schools, instruction in the special details relating to organisation and development of school gardens is given. When it is remembered that many teachers have in the past arrived at a school to find the school garden either non-existent or in a grossly neglected condition, it is plain how important is a course in organisation and planning.

Improvement of College Grounds.

The wonderful improvement in the College Grounds over the last five years, has mainly been brought about by the work of the students themselves, which of course has been under supervision.

The idea has been to try and get each year of students to leave some definite result of their handiwork in the Grounds. The influence of this would undoubtedly be considerable, especially at such times as the Old Boys return to the College when it is hoped that each and all of them will be able to recognise the results of his own earlier handiwork. At the same time an element of competition is introduced which inspires each year to try and improve on its predecessor. In the matter of crops grown, the high standard attained by the students is very evident in the exhibits put up at the various Agricultural Shows and in the large percentage of prizes in all classes which they carry off at such functions.

The Students' Future Work.

The real problem begins when the student leaves the College and takes up his post as a teacher in the village school. It is here that the true test of progress or lack of it, becomes evident. The mind of the child is like a mirror and reflects back the mind of the master. It is absolutely essential that the teacher should be an example to his pupils, *e.g.*, he himself should be keen and willing to work in the school garden with his children and his own garden should be a model, fit for the pupils to copy. It is now that the practical side of his training at the College serves him in good stead. In many cases he has a piece of barren ground to plan out and develop into vegetable, fruit and flower gardens. But in any case he will never inherit a piece of ground which is not capable of improvement and development, and if he shows enthusiasm and ability in this sphere, his scholars will soon do likewise. The good work which is already accomplished in schools in relation to native agriculture is evident here also in the exhibits and large number of prizes which these exhibits obtain at Shows, &c. This procedure should be encouraged to the fullest possible extent, as competition always creates healthy activity. The instructional notes which are issued by the Education Department to teachers to aid them in the carrying-out of their duties are fairly comprehensive and the following summary of them may prove interesting, at the same time giving an idea of the work attempted in vernacular school programmes of rural science.

Every teacher should make a plan of the school gardens, showing improvements and forms of cultivation, *e.g.*, vegetables, fruits, flowers, &c., together with plots of the individual pupils.

In order to facilitate planting and cleaning, vegetable plots should not be more than four feet wide. Each should be numbered and should bear the pupil's name.

Each of the higher forms should have a communal plot to teach the value of co-operative labour.

Every pupil should keep a note-book recording instructions given in gardening, together with the day when the seed was planted, when it sprouted, when it flowered, &c., weight of crops, pests encountered, &c.

One of the older pupils should be in charge of school gardens under a teacher, and one pupil should be in charge of the work of each standard, another of seeds, another of crops.

The teacher should award marks twice a term both for individual and for communal plots.

Produce of the school crops may be divided among the students responsible and taken to their homes, or they may be sold and the proceeds used for school purchases, *e.g.* on prizes for gardening or school sports. Careful accounts of expenditure and receipts should be kept.

All teachers must remember that they are expected themselves to work in the gardens, and that class work is only a preparation for gardening work.

The visiting officials of the Education Department regularly inspect the entire work of the school, including the practical work in rural husbandry and marks are allotted for cleanliness and condition of school gardens, and full credit is given in the annual grading scheme. This system is working satisfactorily, but there is no doubt that if the co-operation and expert advice of Agricultural Officers throughout the Peninsula was directly available to the schools by means of periodic

visits, an enormous improvement in school gardening could be brought about. If native agriculture is to be raised to a higher level and the general exodus from the rural localities to the towns is to be lessened, the school is the place where it can be most easily accomplished. After these periodic visits, full reports should be made and any necessary action taken by the Inspector of Schools. Then, if desired, further reference can be made to the Sultan Idris Training College, Tanjong Malim.

Pupils' Home Gardens.

One method of giving a stimulus to native agriculture which has been most successful in several other countries is the introduction of pupils' home gardens in conjunction with the school garden. At the present time the Departments are giving this matter their very careful consideration and attention. The schools with the earnest co-operation of the Agricultural Department could undoubtedly effect advancement in the following direction :—

(1) Improvements in general method of cultivation.
(2) Use of good seed.
(3) Introduction of improved implements.
(4) Introduction of better livestock.
(5) Introduction of new crops.

The introduction of any improved practice from one district to another is good, *e.g.*, drilling. The local farmer does not travel much, so his outlook is narrow. Rice is still broadcast in some places, but in better areas it is transplanted, which is much more effective.

The use of good seed is a very efficient method of getting the confidence of the native. The results are immediately apparent to him and he incurs no extra cost. No better distributing centre than the school could be found.

The introduction of new implements requires great care and study, though it strikes newcomers to the Tropics as the first means of improvement. The native seldom has any ready money and this is a hindrance to the introduction of anything new in the way of machinery. Then the organisation and supply of spare parts is another difficulty. Carpentry work in the school also affords fine opportunities for improvement in this sphere.

Improvement of livestock, though perhaps a little beyond the province of the school's activities, yet is of prime importance and the theory and advantages should receive full attention in the class. If possible, pupils should be taken and shown any improved livestock in the vicinity.

The introduction of new crops is another improvement which looks very attractive to the newcomer but requires to be very carefully handled.

The aim of the Government is to make each school a hive of industry and the centre of native agriculture in each district and around which improvement in conditions may be expected to concentrate. This is only possible where there is earnest co-operation between the Agricultural and Education Departments and the best means of using this co-operation is by periodic visits, as already stated. What has been accomplished up-to-date is by no means discouraging, and very noticeably less so where the co-operation of the two Departments is an accomplished fact.

Effect and Objects of Training.

The deep effect which this type of training has on the attitude of the Malay schoolboy towards manual labour of all kinds, cannot be better expressed than in the following quotation from the Director of Education, "The old-fashioned Malay teacher, puffed up with a little learning and full of the old oriental scholar's prejudice against manual labour, was ashamed to dig ; he now delights in handicrafts and in practical acquaintance with the rotation of crops, the selection of seeds and the study of pests." The attitude of the new teacher is reflected in the new pupil. The new pupil has begun to realise that his education in the school is a real preparation for life.

The test of all education lies in the efficiency and ability derived by pupils from that education, as applied to their future work. Native education must, in particular, be essentially practicable and applicable to the particular set of conditions encountered. If the qualified pupils are qualified only on paper and are of little practical use in the advancement of local conditions, then the education is a failure, no matter how thorough and painstaking it may have been. Educational success can only be judged over long periods, as the process of evolution is naturally a slow one. Short-period results may be very misleading. However, it is hoped that the Rural Husbandry Course which has been described in this article will be successful in stimulating interest in the subject and be of greater value when applied to local conditions.

COLONIAL APPOINTMENTS.

The following appointments and transfers have been made by the Secretary of State for the Colonies :—

Mr. G. H. Gethin-Jones, Soil Chemist, Agricultural Department, Kenya.

Mr. H. Evans, Physiological Botanist, Agricultural Department, Mauritius.

Mr. M. H. French, Biological Chemist, Animal Nutrition Research, Tanganyika Territory.

Mr. W. G. Higgins, Agricultural Field Officer, Federated Malay States.

Mr. C. M. Maggs, Horticultural Assistant, Department of Agriculture, Federated Malay States.

Mr. V. Liversage, Agricultural Economist, Kenya.

Mr. E. Harrison (Deputy Director of Agriculture, Kenya), Director of Agriculture, Tanganyika Territory.

Mr. W. Small (Mycologist, Department of Agriculture, Ceylon), Director of Agriculture, Nyasaland.

FRUIT STORAGE.

A Suggested Experimental Programme of Tomato Storage.

By L. P. McGuire.

[*This article has been published in answer to numerous requests regarding various vegetable commodities which the West Indian Islands propose to export shortly. It is understood from correspondence through the Consulting Refrigeration Engineer for the Crown Colonies that several of the Islands are installing harbour pre-cooling stations. The question of pre-storage factors of nutrition—soil and climate—the influence of variety, &c., on storage life, make it imperative that each Island conduct storage experiments according to local requirements. The Low Temperature Station, Imperial College of Tropical Agriculture, Trinidad, B.W.I., has been frequently consulted in the matter of the Canada-West Indies development so that standardisation in experimental methods will facilitate co-ordination of results, and it is the author's pleasure to quote below the normal procedure adopted by the Low Temperature Station, Cambridge.*]

Introduction.

In studying the behaviour of a fruit in cold storage, the suitability or otherwise of a particular set of conditions is decided by the "Commercial Storage Life" which has been defined as the length of time the fruit can be stored before the loss due to fungal rots or functional (non-parasitic) diseases amounts to ten per cent. In assessing this percentage, wilting, spotting or superficial blemish is not taken into account, unless of a nature sufficiently serious to diminish the value of the tomatoes considerably. While tomatoes are being referred to in particular, the method applies also to other commodities. The method of procedure in Cambridge is as follows :

On arrival at the Station the fruit is put into trays, each containing 100, individual fruits having been thoroughly examined and only perfectly sound ones being selected for the purpose of the storage trial. Care should be taken to make the trays as representative of the consignment as possible. The fruit is then put into storage and at regular intervals one tray is removed and each fruit examined carefully for visible rots. If a fruit appears sound externally it is cut up to see whether it is internally sound as well. The percentage of unsound fruit is noted. The experiment is continued, until, on examination as above, the wastage is found to have amounted to ten per cent. or more. It will be clear then, that if under one set of conditions, the tomatoes have a "Commercial Storage Life" of forty days while a comparable lot under a second set of conditions take only thirty days before wastage amounts to ten per cent., the former is to be regarded as the more suitable set of conditions.

The number of trays required for an experiment and the intervals at which the fruit should be examined, will depend upon the length of time the commodity is likely to last. In this tomato work it is suggested, especially at the commencement, that at least five trays be used and that fruit be cut and examined at short intervals of about seven days. Experience later will decide whether the fruit may be examined at longer intervals.

A number of experiments are formulated below under convenient headings for the sake of clarity.

No. 1.—Temperature.

One of the first points on which information is required, is the optimum temperature of storage. Trays of fruit carefully picked, examined, &c., as above, are divided into two similar lots, the first to be placed in a chamber at 32°F. and the second at 36°F. and the examinations carried out at regular weekly intervals, the wastage being noted. If a third chamber is available a comparable consignment might be held at 40°F. The experiment should be repeated by way of confirmation.

The next experiment should be carried out with change of temperature. As a standard of comparison, one consignment should be stored at the temperature found most suitable in the first experiment (suppose 36°F.) and the next would be stored at 34°F. Confirm. According to the result the next experiment will be conducted at 36°F. and 38°F. respectively or 34°F. and 35°F., and so on. In this way the optimum temperature will be arrived at.

The above presumes that there are two storage chambers available ; if only one the different temperatures must be tested out in turn, and the "Commercial Storage Life" at those temperatures will indicate which is most favourable. Great care should be taken to keep other conditions as standardised as possible. The question of varying humidity and concentration of carbon dioxide in the storage atmosphere may be conveniently left over for the time being.

No. 2.—Variety.

The behaviour of different varieties of tomato at the different temperatures commends itself as an essential subject for study since it is highly probable that the optima temperatures of storage will vary with varieties. The same procedure is adopted in the matter of putting into trays, &c., but the trays should be labelled so that the different varieties could be kept separate, thus facilitating observations of each variety throughout the storage trial.

No. 3.—Maturity at Picking.

The question of the precise stage of maturity at which to pick the tomato for transport in cold store is vitally important. While two workers have reported their ability to keep tomatoes (variety unknown) for periods longer than one month, the concensus of opinion inclines to the view that the tomato is a fruit of very limited storage life. Thus,

for the purposes of longer journeys certain varieties are picked green. It is suggested that experimental work be conducted with fruit picked at four different stages of maturity :—

1. Green, not full-sized.
2. Green, but fully grown.
3. Commencing to colour.
4. Ripe.

The fruit having been carefully reaped (clipped with scissors or similar instrument leaving a small portion of stem on the fruit, and not pulled) and brought to the station should then be sorted in to the four grades : each grade is now put on trays (100 per tray). If the fruit does not all arrive from one locality then all trays should contain the same number of fruit of a particular origin :—in other words the fruit in one tray of a set should resemble as closely as possible the fruit on the other trays of the set, in size, maturity, place of origin, &c. In this set of experiments, a few days at ordinary temperature after removal from the cold chamber should be allowed for the fruit to ripen up. The examination and cutting up, &c., can then be proceeded with in the usual way and the correct stage of maturity for picking decided. Failure to colour up within a reasonable time after removal from cold storage should be taken into account when assessing "Commercial Storage Life."

No. 4. Effect of Exposure to Tropic Temperature.

It is difficult to formulate laboratory scale experiments under this heading since the problem is essentially due to the complex of bulk. In the writer's experience, the exposure, *per se*, to 80°F. for three hours after thirteen days in cold storage caused no appreciable difference. It must be remembered, however, that a small consignment of 100 tomatoes on being put back into cold store would very quickly assume storage temperature, and enter into a state of dormancy with consequent low respiratory activity. But the matter would be very different in the case of large consignments of crated fruit. The use of insulated barges to the ship, expeditious handling to reduce to the minimum the exposure to tropic temperatures, and adequate refrigeration efficiency on the ships, would contribute towards improvement of cargoes.

In replies to the various Islands the advisability of using insulated barges, preferably refrigerated, for the transport of fruit from the pre-cooling station to the ships' holds so that the advantages of pre-cooling may not be lost, has been stressed. The cold air system of refrigeration with facilities for exhausting the storage atmosphere, and removing storage gases should help considerably.

It is therefore suggested that controlled experiments be conducted with exposures to outside temperatures of different duration after 3, 6, 9 and 12 days respectively of cold storage, the fruit being put back into cold store and the "Commercial Storage Life" calculated in the usual way and contrasted with comparable lots which have not been exposed. Being satisfied that the exposure *per se* is not harmful, or that certain exposures are not harmful, large scale work with tomatoes, crated as for export should then be commenced. Fruit for this should be carefully reaped at the optimum stage of maturity for picking, stored at the optimum temperature, given the optimum* duration and put back into cold store and left for a period equivalent to the voyage to Canada plus a few days for ripening and marketing. The crates are then opened and the wastage calculated. If possible a comparable consignment should be sent to Canada and a report of their condition requested from a reliable source. When the preliminaries mentioned above have been worked out much valuable information should accrue from such experiments.

No. 5.—Wrappers.

The use of individual wrappers for tomatoes has been shown to retard the ripening process considerably; comparative tests with different wrappers might very profitably be undertaken later.

No. 6.—Locality.

The marked influence on locality on the length of storage life of different commodities has been reported by several workers. At a later stage comparison of "Commercial Storage Life" of varieties grown in different localities should be undertaken and the export of tomatoes from unsuitable localities discontinued.

The foregoing which by no means covers the whole field, nevertheless embraces the more important points upon which information is urgently needed.

* These optima conditions will have been determined in earlier experiments.

REVIEW.

Plants of the Gold Coast.

By F. R. Irvine, D.Sc., F.L.S. *Humphrey Milford*, London, 1930, pp. 521.

Described in the preface as the first attempt in print to revise and augment Dr. T. F. Chipp's lists of *Trees, Shrubs and Climbers of the Gold Coast* and *Herbs and Undershrubs of the Gold Coast*, this work should prove of considerable value in the country of its origin and find definite if more limited usefulness in a wider sphere.

The main part is an alphabetical list of botanical names, to each of which is added, as far as possible, various native names, a brief description, the ecological distribution and notes on native uses and proverbs or traditions connected with the plant. This list is supplemented by notes on types of vegetation, a list of economic plants, a botanical (systematic) index, a full general index of English and West African names, and special indexes of certain native languages.

The illustrations, both photographs and line drawings, are numerous and good, and the standard of the production is commendable.

E. E. C.

MALARIA AND QUININE.

[*The three-hundredth anniversary of the first recognised use of cinchona by Europeans was celebrated recently at the Wellcome Historical Medical Museum when a number of important addresses were delivered. Some of these are reproduced below from "The Lancet," Vol. II, No. XXVI, and the "British Medical Journal," No.* 3652.]

History of Cinchona Bark.

SIR DAVID PRAIN in an address on this subject said that the trees exploited in the forests of Loja, now Southern Ecuador, had been first examined critically, by members of the French Scientific Expedition under M. de la Condamine, which had spent the period 1737-43 in the measurement of the arc of a meridian in South America. The Botanist of the expedition had been Joseph de Jussieu. As the result of his observations, Linnaeus, in 1742, had been enabled to found the genus cinchona in honour of the lady alleged to have brought the bark to Europe. It had been said that the natives who collected the bark had not known of its medicinal properties, but had believed it to be wanted for tanning leather or dyeing cloth. Natives, however, were not always anxious to convey their knowledge to their neighbours. The Marquis de Merry del Val had expressed the opinion—long held by the speaker that the Indians had been well aware of the virtues of the bark, and de Jussieu had said that Jesuits in Peru knew its value in 1600. In this case the tercentenary was being celebrated a generation too late. By whatever means the bark had reached Europe it had been known in Rome in 1639, having been sent to a Jesuit who had been sent there from Spain and in 1643 had become a Cardinal. The Jesuits had distributed the bark free to the needy and charged a high price for it to the wealthy. From Italy it had found its way to the Low Countries and thence to England, where a fortunate apothecary, one Talbor, had cured Charles II with it. He had thereby incurred the enmity of the London practitioners of his day and persuaded politically minded persons to assert that Charles must be a Catholic or he would never have taken the bark recommended by a Cardinal. Indeed, the name of Jesuit's bark had long stood in the way of its use in medicine. Talbor had subsequently cured Louis XIV, who had bought the secret for £2,000 and made it public. It found favour with the courtiers; Lafontaine had written a long poem in honour of "Quinquina" and in 1681 Mme. de Sévigné had written that it would soon become the fashion to take the bark after every meal like tea or chocolate. Racine, in a letter to Boileau had said he did not know the honest man who, if he had taken quinine without effect, would have the hardihood to say so.

The cinchona bark recognised in the London pharmacopoeia of 1677 was the "Crown bark" of Loja; red bark appeared a century later. The exploitation of the forest product had led to gradual diminution of supply and increased cost of collection. In 1735 Ulloa had called attention to the fate likely to befall the trade unless measures of forest conservation were taken. By 1785 the red bark (*Cinchona succiruba*) had been in general use in Europe and had been considered as useful as *C. officinalis*, and by 1790 yellow bark from Bolivia had become popular. In 1792, Fee had urged South America to cultivate cinchona, but instead exploitation in New Grenada had been undertaken. With the exhaustion of grey and yellow barks the exploitation of Columbian barks set in, and at last cultivation had been started: by France in Algeria in 1849, by Holland in Java in 1854, and by England in Ceylon and South India in 1861. Many climatic difficulties were, however, encountered; the climate of India was suitable but the soil was less satisfactory. Moreover, there was a difference in the adaptability of particular kinds of cinchona to change conditions: Columbian barks had not flourished in Asia; red and grey bark had accommodated themselves, even to the unsuitable soil and climate of the Himalayas, and yellow bark grew in Sikkim and Burma but not in Ceylon and South India The alkaloid content of different barks also varied and the cultivator had to pay attention to the selection of strains and still more of particular kinds. From the economic standpoint the nature of the alkaloids was even more important than their total amount.

Therapeutics of Cinchona.

Sir Humphrey Rolleston who reviewed the history of quinine with many interesting and erudite anecdotes, said that about 30 alkaloids had been obtained from cinchona bark, and they were all general protoplasmic poisons. The crystallisable ones were quinine, cinchonidine, quinidine and cinchonine. The most powerful antiseptic was quinine followed in order by quinidine, cinchonidine and cinchonine. Quinidine was less effective in malaria than quinine, but was the most valuable in restoring the heart rhythm. Cinchona and its alkaloids had been used in a very wide variety of diseases. It had been given in fevers of all kinds, especially in the early days. Its vogue in the prevention of malaria was only second to its curative effects. Its reputed antipyretic action could not be explained by any influence on protein metabolism (Hardikar). On account of their action as general protoplasmic poisons, quinine and its derivatives had some action as local anaesthetics acting on the nerve-ending. Bromides had largely superseded quinine in Meniere's disease because its local toxic action caused Labyrinthine disorder. Small doses increased the activity of smooth muscle and had been thought to shorten labour and favour uterine retraction. The alkaloids were the only real specific for malaria, although hundreds of other drugs had been recommended. In 1791 A. E. Brande had declared that angostura bark was as good in ague, dysentery, and putrid sore throat. In 1792 Samuel James had published observations on the superiority of a species of

willow in the cure of agues, intermittent fevers, fluor albus abscesses, haemorrhages, while in 1803 G. Wilkinson had advised broad-leafed willow bark for various diseases. In 1793 William Roxburgh had compared a species of mahogany with the Peruvian bark. More recently organic arsenical preparations had been shown to be useful adjuvants, but were not specifics. Thomas Fowler (1763-1801) of "Fowler's solution" had written to Andrew Duncan that on several occasions he had been cured of remittent fever by eight drops of the "mineral solution of arsenic" thrice daily. The statement that malarial parasites might become resistant to quinine was based partly on reports of cases, and partly on the analogy with trypanosomes and other protozoal parasites. In fact, however, quinine resistant plasmodia were very rare. Cases where quinine seemed not to control the fever were probably accounted for by failure of absorption or inadequate dosage. How exactly it exerted its action was not yet clear; it might act indirectly or by producing a metabolite in the tissues. Hatcher and Weiss had estimated that 95 per cent. of quinine injected intravenously disappeared from the blood in five minutes and thought that it collected in the capillaries. Another view was that quinine favoured the production of antibodies and it had been thought to form a film on the corpuscles and so prevent the entrance of the parasites. Quinidine was the dextro-isomer of quinine; its real nature had been determined by Pasteur in 1853. It had, weight for weight, five times as powerful an action as any other alkaloid in restoring the normal heart beat in auricular fibrillation. Hydroquinidine, the chief impurity of commercial quinidine, had a slightly more powerful action. Ethyl-hydrocupreine had been advocated for pneumococcal infections, but had proved disappointing in man.

Quinine Therapy in Malaria.

Mr. T. E. Wallis spoke on certain aspects of the study of cinchona, describing work as a result of which the pharmacognosist was able to define the bark most suitable to the physician, to control the identity of the whole and the powdered drug, to analyse materials containing the drug, and to suggest new directions in which the bark may possibly be still further utilized. Major-General Sir Charles MacWatt, who was Director-General I.M.S. from 1922 to 1926, gave an account of his experience of epidemics of malaria in British India, mentioning that for twenty-five years in India he had taken a daily ration of quinine as the only means of keeping himself free from recurring attacks of chronic malaria. He also spoke of cinchona cultivation in India. There were Government cinchona plantations in the Nilghiris in South India, in the Darjeeling district in Bengal, and a quinine factory in the Madras and Bengal provinces. A crop of cinchona rendered the soil, at least for some time, incapable of producing a satisfactory second crop; so that an unrestricted area of suitable forest land was required to enable the earth rendered sterile by the first crop to be abandoned and another crop to be planted on virgin soil. In his opinion the time had come for further efforts to increase the production of cinchona and quinine within the British Empire. In India the production of cinchona could be greatly increased by extending the area under cultivation and by more intensive cultivation. The final address was given by Dr. P. Manson-Bahr, on quinine therapy in malaria from the aspect of the practical physician. He said that of the three species of malaria parasites causing three clinically distinct diseases the benign tertian and the subtertian were the most generally distributed, and the quartan the most infrequent. Subtertian fevers were most amenable to quinine therapy, the other two much more refractory. The primary attack was more susceptible to treatment than were relapses. The resistance of the body to infection was often overlooked; in addition to specific therapy, every other aid must be enlisted to augment the *vis medicatrix*. Lowering of body resistance in a debilitating tropical climate was the underlying cause of the apparent failure of quinine therapy. Quinine exerted its maximum effect if given when the acute paroxysm was declining and the patient was beginning to sweat, for at that moment the parasites had sporulated and the merozoites were free in the blood plasma and most susceptible to the action of quinine. A good method for removing the bitter taste was to prescribe it in a mixture with ten grains of citric acid, to which were added four grains of ammonium carbonate, and 20 grains of potassium bicarbonate. Even by continuous quinine therapy the non-occurrence of relapse could not be guaranteed; and in order to avoid relapse the resistance should be built up by good food, fresh air, and moderate exercise. There were grounds for thinking that in the quiescent stage salvarsan had some action on the parasite, or at least exerted a definite tonic action on the body, so that he was in the habit of combining one or more injections of 0.3 grain of neosalvarsan as adjuvant to quinine therapy. He was sure that quinine did not exert its maximum effect unless the intestinal tract was in a receptive state for its absorption; therefore a saline aperient should be given at the commencement of quinine treatment and thereafter once or twice weekly. In subtertian infections such large doses were not needed as in benign tertian. One could commence with 15 grains of the alkaloid in solution, generally given by the mouth (except in the more severe clinical forms, with bilious vomiting when a smaller amount should be given intramuscularly), and the dose by the mouth could be gradually increased to 30 grains daily. In very severe toxic cases of subtertian infection the pushing of quinine must be avoided on account of the liability to blackwater fever. Dr. Manson-Bahr mentioned plasmoquine. He believed this compound a useful adjuvant to quinine treatment and in many circumstances an efficient substitute. It had certainly opened up vistas, the exploration of which might yield less toxic and even more specific antimalarial drugs.

Dr. H. H. Dale, director of the National Institute for Medical Research, commented on the curious fact that the medicinal treatment of malaria had changed only in detail during the last 300 years, in striking contrast to that (say) of syphilis or kala-azar. The cinchona alkaloids were still without a serious rival in the treatment of malaria, but why these alkaloids in particular were antagonistic to malaria infection remained a mystery. It was, he said, the great merit of Ehrlich that he had focused the search for remedies acting on the causes of infection, not simply on its symptoms; the resounding success which he achieved in the case of salvarsan had led to a hope of establishing a general connection between chemical structure and biological effect, which was not yet realised. We were still at best only groping towards it. Although nothing better than cinchona had yet been synthesised, the work of W. Roehl on the action of the synthetic plasmoquine opened up a new field of investigation. Dr. C. M. Wenyon, Director-in-Chief of the Wellcome Bureau, gave some striking illustrations of the prompt action of quinine on the malarial parasite, although, he said, cinchona is powerless to prevent malarial infection. He was one of those who doubted the value of the daily prophylactic dose, if continued for longer than a month or two; but he looked forward to the day when there would be no more malaria and people would refuse any longer to tolerate the mosquito.

CITRUS PROSPECTS FOR 1930-31.

THE bearing acreages of oranges and grapefruit are being steadily increased. Many trees now in bearing have not reached the age of maximum yield and a large increase in production may be expected in years when favourable growing weather prevails. Adequate returns to the growers are dependent upon a continuation of the upward trend in *per capita* demand.

The trend of grapefruit production is sharply upward in all producing sections. In Florida about 80,000 acres have been set to grapefruit. Most of the acreage is now in bearing but many of the trees are not yet full size. Production is increasing about five per cent. a year, and will continue to increase for several years more. The California bearing acreage is reported as 10,000 with a forecast of 11,800 bearing acres in 1932. Texas with an acreage of 60,000 has only 17 per cent. of this acreage of bearing age. The April survey of plantings in the lower Rio Grande Valley of Texas, made by the Federal Plant Quarantine and Control Administration, indicated some 713,000 grapefruit trees five years old or older as compared with 300,000 trees four years old, 445,000 trees three years old, 814,000 trees two years old, 1,214,000 trees one year old, and 716,000 trees under one year of age. The acreage in the valley comprises 40 per cent. of the total acreage planted to grapefruit in the continental United States. Although the frost that occurred in 1930 nipped back many of the younger orchards and has reduced the size of the crop for harvest during the 1930-31 season, the set-back of the industry appears to be temporary. Production is also increasing rapidly in Arizona. Porto Rico, with an acreage estimated at 3,800, is reported as rapidly recovering from the damage resulting from the hurricane of 1928.

Canning of grapefruit has been increasing rapidly during the last five years. Last season 1,316,000 cases were packed as against 400,000 in 1925-26. Reports from Florida point to a marked increase in the pack for the coming season.

Increasing consumption of grapefruit in foreign countries may be expected to continue, but foreign grapefruit production is also increasing. In other parts of the world, as in Palestine, West Indies, Brazil and South Africa, production is increasing to meet this growth in foreign demand. Florida and Porto Rico have previously supplied the bulk of the grapefruit shipped to European markets, but United States growers must expect more competition in these markets in the future than has been felt in the past. Growers of winter oranges can expect an outlet in Europe for only a relatively small quantity of the higher grade fruit in view of the keen competition from Spain and Palestine.

The Federal quarantine on Florida products on account of the Mediterranean fruit fly was lifted on 15th November by order of the Secretary of Agriculture.

In view of the prospective large increase in production, especially of grapefruit, during the next few years, brought about by increase in number of bearing trees and continued heavy plantings, and in view of the resulting probable depressing effect on prices, new plantings, except for grove replacements, appear to be justified only where unusually favourable conditions exist for the economical production of good quality fruit.—(*United States Dept. of Agriculture Miscellaneous Publication*, No. 102.)

COLLEGE MEMOIRS.

The following can be obtained on application to the Editor:

Economic Series:

No. 1.—The Sugar Industry of the British West Indies and British Guiana, with special reference to Trinidad	C. Y. Shephard	1*s.*

* * *

Sugar Technology Series:

No. 1.—Cane Syrup	R. H. Hurst	1*s*
No. 2.—Experiments with Final Molasses	J. A. McDonald	6*d.*
No. 3.—Sampling of Cane in the Field	J. G. Davies	6*d.*

* * *

Mycological Series:

No. 1.—Collar and Stem Canker of Pigeon Pea	R. Leach and J. Wright	6*d.*
No. 2.—Control of the American Leaf Disease on Arabian Coffee in Trinidad	H. R. Briton-Jones	1*s.*
No. 3.—Observations on Cypre in Trinidad	H. R. Briton-Jones and R. C. Marshall	8*d.*

THE IMPERIAL SOIL BUREAU.*

SIR JOHN RUSSEL, D.SC. F.R.S.
Director of the Bureau and of the Rothamsted Experimental Station.

IN recent years, there has begun an important movement towards organized development of the Empire. The problem is complicated by the wide diversity in conditions of the different parts of the Empire, and by the fact that some of its units are entirely self-governing, so that organization has to be a matter of mutual agreement, and must proceed along lines representing the greatest measure of common consent.

The Empire depends largely on its agriculture; indeed, in the main it can be called an agricultural Empire. There is as yet no imperial organization on the business side, but on the scientific side the organization has been developing. In the nature of things, the scientific agriculturists of the Empire are widely scattered; many of them are remote from libraries and laboratories, and cannot keep in touch with modern investigations elsewhere. Even workers in large, well-equipped institutions, provided with good library facilities, find this difficult; modern agricultural science is so intricate and specialized that no one man can claim a knowledge of all of it; sometimes, indeed, the specialists in the different branches can hardly understand each other's language. This is a recent development: when Warrington wrote *The Chemistry of the Farm* in 1881, he could safely deal with the whole subject; no one who knew much about it would attempt to do so now.

The difficulty is accentuated by the fact that agricultural science is now being developed in a large number of different countries. The wave of nationalism that has passed over the world since the war has led to the revival of languages not previously used for scientific or literary purposes. Before the war, practically all the important work in agricultural science was published in about six languages—English, French, German, Italian, Dutch and Scandinavian; as most of the workers could read at any rate the first three or four, it was possible to keep in touch with all that was going on. To-day the Rothamsted library receives journals on agricultural science in more than 20 languages, and any of these papers may be important. Although scientific workers have from time to time threatened to learn no more languages, the journals continue to appear. The quality of the work is unequal: some is poor, especially when, as happens in places, men are appointed to agricultural colleges solely on the score of nationalism and not of efficiency; but some is good, some very good, and all must be examined.

Now it is palpably impossible for the agricultural expert, busy with his own problems, to read all this enormous mass of literature in so many different tongues. It is equally impossible for him to leave it alone, for economic conditions everywhere require that the farmer should be given all the technical and scientific help possible. The work must be done for him. It was therefore decided at the Imperial Agricultural Research Conference in 1927 that several Bureaux, additional to those already functioning, should be started in Great Britain to supply workers in each part of the Empire with information about investigations elsewhere, and also to keep each one informed of what the others are doing. One of the new Bureaux was created for the study of soils. It was started at Rothamsted on 1st May, 1929, with the writer as Director, and Dr. A. F. Joseph, late of the Sudan Government Service as Deputy Director. Dr. Joseph is assisted by Miss H. Scherbatoff, a Russian lady with a thorough knowledge of some six or seven languages, and a good working knowledge of several others, and by Mr. A. J. Lloyd Lawrence, formerly of Caius College, Cambridge.

The first duty of the Soil Bureau, as laid down in the memorandum of foundation, is to maintain an index of the researches being carried out in different parts of the Empire, and, as far as practicable, in foreign countries, and also to collect information from all sources relating thereto.

Its next duty is to distribute information about soils to officials and advisory officers in all parts of the Empire. This information includes bibliographies and photostat copies of papers or tables; where possible the loan of papers. At the moment, no printed journal or bulletin has been sanctioned, and the distribution of general information is by typewritten circulars. Experience will show how far this method suffices.

Although fertilizers are not specifically mentioned in the foundation memorandum, they are so closely related to soils that we regard them as coming within our purview, and this is the more readily done since Rothamsted is the home of fertilizer experiments. The compiling of an index of research on soils and fertilizers in the Empire is now well in hand. The information, when assembled and classified, should prove very valuable.

Several memoranda have been circulated already to the soil workers of the Empire. Being intended only for experts they deal with highly technical subjects, but they summarize information which is not easily accessible; their general purpose is to help with the unification of methods of soil analysis. Till recently there was no agreement; each worker chose whatever methods he liked. The result was that a soil analysis made in one country did not necessarily mean the same thing as an analysis made in another; two different soils could give the same figures, and one and the same soil could give different figures according to the particular methods used. This greatly diminished the value of the analysis, because it obscured resemblances and relationships that might have been helpful to the investigators.

* *Journal of the Ministry of Agriculture* Vol. XXXVI, No. 10.

In the last few years, a considerable amount of agreement about mechanical analysis has been reached by soil workers, and an international method has been drawn up and used sufficiently to reveal some of its advantages and disadvantages. The Empire soil workers, however, have not all adopted it, preferring to wait and see how it turned out.

The first memorandum issued by the Bureau dealt, appropriately enough, with this proposed method pointing out the types of soil for which it has not proved satisfactory, the difficulties already discovered, and the ways in which some of the difficulties have been overcome. References are also given to some of the critical papers.

The second memorandum dealt with another analytical process about which there is as yet no international agreement; the determination of the organic matter in soils. The various groups of methods are set out, particularly a new and simple one which may prove of general interest.

The third memorandum directs attention to the desirability of making a soil map of the Empire, as one of the essential requisites for organized development of Imperial agriculture. While adequate methods of classification are as yet undeveloped, and in consequence the necessary basis is incomplete, sufficient is known to allow of a satisfactory beginning. An actual illustration being better than any amount of *a priori* discussion, a recently-constructed soil map of the Sudan was circulated. Concrete suggestions are made for a soil survey of the tropical parts of Africa coming within the Empire, and the services of the Bureau staff are offered for the collation of the results.

Other memoranda for circulation are being compiled on soil erosion, green manuring, field experiments (especially methods of lay-out and treatment of results), soil classification, determination of soil alkali and clay; all these being of importance to large parts of the Empire. At present, these memoranda are circulated in accordance with the foundation memorandum, through the official correspondents in each part of the Empire; they are not sent direct to the actual workers. Whether this method will continue, remains to be seen. In addition, the Bureau is drawing up a list of periodicals, including Reports of Experiment Stations, that deal with soil and fertilizer problems; this list will be available to all workers.

A considerable amount of time has been spent in answering enquiries. These arrive direct from the soil experts, and necessarily involve a great deal of labour in collection and critical examination. Among the enquiries, have been several on the effects of manganese in soils, on erosion, laterites, silicates, and different aspects of soil analysis. They have come from various countries of tropical Africa—the Sudan, Kenya, Uganda, Sierra Leone—from Palestine, Burma and Ceylon, from Quebec, also from England—which, as part of the Empire, is also to be served by the Bureau.

The Bureau will also help soil workers proposing to visit England, furnishing introductions and itineraries, arranging with universities or other organizations in this country for anything desired from post-graduate study to short visits taking only a day. Further, it informs soil workers of conferences likely to interest them, and generally adopts whatever steps lie in its power for helping all who are engaged in studying the soils and growth of crops in the British Empire.

The staff is very anxious to do all in their power to make the Bureau an effective and useful organization for the development of the agriculture of the Empire; they cordially welcome suggestions from Empire workers indicating other services which the Bureau may be able to render.

WATER BALANCE IN PLANTS.

The Water Balance of Plants as a Factor in their Resistance to Insect Pests.

As a result of a review of the available evidence with regard to the effect of climatic and soil conditions on the distribution of the *Dysdercus* sp., the hypothesis was put forward by E. P. Mumford (Pacific Entomological Survey) in 1925-26 that a disturbed water content, from whatever cause, rendered the cotton plant more susceptible to the attack of sap-feeding insect pests, such as various species of thrips. Later it was found that this hypothesis appeared also to hold true in the case of certain sap-feeding insect pests of sugar-cane, notably the froghopper *Tomaspis saccharina* Dist. So far as cotton is concerned, the hypothesis has since been confirmed by observations made in the field in California.

In the autumn of 1926 several extensive tours were made into the cotton-growing regions of California, which included not only the well-known Sacramento, San Joaquin, and Imperial Valleys, but also the lesser known Ferris, Coachella, Palo Verde, and Barde Valleys. At that time more than 160,000 acres of cotton were growing in California proper, an additional 130,000 acres occurring in Lower California. It was then found that thrips (*Heliothrips fasciatus* Perg.) attack on Acala cotton invariably followed faulty irrigation practice. Thrips were never found in large numbers on plants receiving an optimum water supply. It seemed that plants suffering from water shortage were definitely more attractive to the attacking thrips.

W. B. Camp, of the U.S. Bureau of Plant Industry, working in collaboration with the Department of Agriculture, has been carrying out a series of experiments on these lines for a number of years, and we have reason to believe that this hypothesis is supported and extended by the results of his researches. It also receives support from Bedford's observations on thrips (*Heliothrips indicus* Bagnall) attack on Egyptian cotton in the Sudan (*Wellcome Trop. Res. Lab., Khartoum, Ent. Sec. Bul.* 18, 1921), though in some respects it

would appear to be contradicted by Wardle's observations on *Thrips tabaci* Lind. attack on cotton in a Manchester greenhouse (*Ann. App. Biol.*, 14, 482; 1927. Compare also MacGill, *ibid.*, 16, 288; 1929).

With regard to the sugar-cane froghopper (*Tomaspis saccharina* Dist.), the hypothesis has also received striking confirmation in practical experiments by Withycombe (*Ann. App. Biol.* 13, 64; 1926. *Proc. Agric. Soc. Trinidad and Tobago*, 26, No. 6, 294; 1926) and other workers in the West Indies. Increasingly we are led to believe that the hypothesis holds true for a large number, but not all, species of thrips, red spider, &c., as pests of a wide range of food plants. Several cases are cited by Lees (*Ann. App. Biol.*, 13, 506; 1926) in which heavy irrigation and heavy rainfall resulted in increased susceptibility to insect attack, but it is not improbable that, in a number of cases, conditions of physiological drought were present as a result of deficient soil aeration.

It seems also that the nitrogen content of the sap is an important factor with regard to susceptibility to attack. This has been referred to by Davidson (*Ann. App. Biol.*, 10, 35; 1923) and by Lees (*loc. cit*). Experiments carried out by E. P. M. on the curly-top disease of the sugar-beet in California, transmitted by the leaf hopper *Eutettix tenellus* Bak. (results to be published shortly in *Annals of Applied Biology*), point in a similar direction. There is, indeed, much evidence available which indicates that a highly nitrogenous diet stimulates reproduction. The two factors, water content and the nitrogen content of the sap. are interdependent, but it would form an interesting problem in nutrition to find which of the two is of the greater importance in any particular case.

The specific rôle of water in the metabolism of plant and insect is not mentioned by Uvarov in his recent memoir and review of the literature on insect nutrition and metabolism (*Trans. Ent. Soc., London*, Pt. 2; December, 1928), although considerable attention is paid to the related subjects of the food of insects and the influence of diet on growth and reproduction. There is also no reference in "Filterable Viruses" (Ed. by T. M. Rivers; Bailliere, Tindall & Cox, 1929) to the water relationships in plants susceptible to virus diseases, but it is a frequent observation that plants so infected have, in general, poorly developed root systems.

In order to understand these diseases more fully, much further work will be necessary on insect nutrition and metabolism, their habits, host-plants, and rates of reproduction and in particular on the specific biological relationships which appear to exist in many cases between the insect and the disease it transmits. In this connection it seemed desirable again to direct attention to the water balance of plants as a factor in their resistance to insect pests.—(*Nature*, Vol. CXXV, No. 3150, p. 411.)

SHEA NUTS AND BUTTER.

THE overseas trade of Nigeria in shea nuts and butter has not made the progress that was hoped for, the increase in volume during the last 20 years being only very slight. The causes are discussed by M. Greenwood, M.Sc. (*Eighth Ann. Bull. Agric. Dep., Nigeria*, 1929, p. 59), who points out that buyers of the butter have been considerably discouraged by the amount of adulteration that takes place, with the result that certain firms have ceased to handle this product. Shea butter (or fat) contains usually from five to eight per cent. of unsaponifiable matter and on this account there formerly existed a certain prejudice against its use for edible purposes, but this is no longer a factor of importance, the real cause of the slow progress of the industry being that shipments are irregular both in quantity and quality. The users of shea butter require kernels containing a minimum of 46 per cent. of oil with a free fatty acid content of not more than 6 per cent.

The conditions affecting the production of shea fruits are considered and it is mentioned that, owing to the varying times at which the trees flower, the crop fluctuates from year to year and from place to place. The factors that have an adverse effect upon the yield are bush fires, tornadoes, insects and overcropping. Shea fruits are generally single-seeded and show a variation in shape and size. One type is round to ovoid with a not very sweet mesocarp, while the other common type is relatively longer, oval to elliptical and with a very sweet mesocarp.

The fruits grown in the north of the shea belt in Nigeria are larger than those from the southern portion and their kernels contain less oil and the oil more unsaponifiable matter. Unripe kernels yield oil containing more unsaponifiable matter than ripe ones. The age and type of the tree does not appear to have any insignificant influence upon the percentage of oil or of unsaponifiable matter.

Shea kernels intended for export are dried either in the sun or in kilns. Either of these methods when properly carried out gives a product which meets the crusher's requirements. The inclusion of germinated kernels and the imperfect storage of sun-dried kernels are the chief causes of deterioration in quality. In sun-drying, the nuts should be dried in the shell as far as possible and, after cracking, the kernels should be dried as rapidly as climatic conditions allow.

The limited overseas demand for shea kernels results in a low price being offered for their collection. The low price is also due to the buyers having to make an allowance for possible shrinkage through the drying of the wet kernels. There is, therefore, only a narrow margin between the price offered by the buyers of kernels for export and that given by the native butter-makers, and but little incentive for the collection and preparation of kernels for export. The article concludes with a detailed account of the methods in use in Nigeria for the preparation of shea butter.—(*Bull. of the Imperial Institute*, Vol. XXVIII, No. 3.)

FUSARIUM CUBENSE.

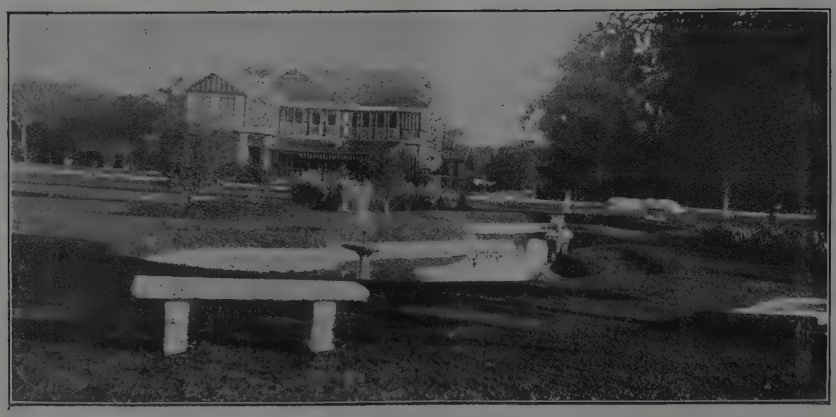
FIG. 1.

Strains of "F. cubense" grown on Richard's solution agar. Top left: *strain showing colony thrown into brain-like corrugations;* top right: *strain showing colony thrown into undulations;* bottom right: *strain showing no warping, and with slight development of aerial mycelium;* bottom left; *strain C growing on Standard Medium, showing sectoring, beginning at the innermost ring.*

(*see* p. 54)

SULTAN IDRIS COLLEGE.

View of main College buildings.



The College Grounds which are under the care of the students.

TROPICAL WORLD NOTES.

Sierra Leone.

The Director of Agriculture draws our attention to the fact that the following have been the exports of the chief produce from the country for the comparative periods shown :—

		Exports from Jan. to Oct., 1930.		Exports from Jan. to Oct., 1929.	
		Quantity.	Value.	Quantity.	Value.
			£		£
Palm Kernels	Tons	45,476	555,699	52,462	769,237
Palm Oil	Tons	2,719	60,889	2,697	71,142
Piassava	Tons	1,80[illegible]	27,680	929	12,446
Ginger	Cwts	38,282	55,313	30,943	59,296
Kola	Tons	1,498	117,950	2,735	235,690
Cocoa	Tons	79	2,518	74	2,619
Peppers	Tons	102	4,211	55	4,762
Rice	Cwts	83	60	200	194

It will be seen that there has been a serious fall in the exports of palm kernels as compared with those of the same period in 1929. Piassava however continues to improve, and the exports up to the end of October exceed those of 1929 by nearly 900 tons. The export of ginger has also maintained its lead over that of 1929, and is in fact the highest for the period for several years.

* * *

Tanganyika Territory.

Tanganyika Territory occupies the centre of East Africa, with Kenya and Uganda as its northern neighbours. It is seven times the size of England but has fewer than 5,000,000 inhabitants, of whom under 6,000 are Europeans. Certain highland areas are suitable for white settlement ; but these are of limited extent, and Tanganyika is essentially a black man's country. For, as in Kenya, the whites who are settled on the land—the majority are British, with Germans and Greeks next in number—are dependent on black labour for working their farms. This being so, the Tanganyika Government holds that the surest safeguard of the interests of the whites (and Indians) is the building up of a strong, contented, law-abiding native community capable of taking its share of administration. By studying ethnology and the working of the native administration an understanding may be reached of the effect of the system of "indirect rule" which has been so marked a feature of Sir Donald Cameron's governorship. The Africans in the Territory are divided into 117 tribes, and speak nearly as many languages. Most of the languages, however, being Bantu, have a general resemblance, and Swahili, the language of trade, is very widely understood. But each tribe has its own customs, and though a few of these tribes total hundreds of thousands, the majority are quite small in numbers. The Government's aim has been to strengthen tribal authority, which had almost disappeared under German rule. The tribes, or groups of tribes, are placed under councils of elders entrusted with administrative, financial and judicial authority ; and under the guidance of sympathetic district officers they have made much progress. This has been partly possible because of the democratic organization of the Bantu peoples in general, for the autocratic sway exercised by the Zulu kings and other potentates is exceptional. Moreover, the natives are assured of ample lands, and the question of providing reserves for them does not appear to arise. No land is now granted to Europeans in freehold, and "the right of occupancy" is limited to 99 years. There are still, however, large areas in the south-west highlands available for white settlers, though until the region is provided with a railway its development can be but slow. Economically the native is an important factor, and on his own account he produces about half of the crops grown for export.—(*The Handbook of Tanganyika*, by G. F. Sayers ; extract from Review—*Times Literary Supplement*, No. 1506, p. 1051.)

* * *

St. Lucia.

It is stated in Colonial Report No. 1495 (H.M. Stationery Office), that the year 1929 was one of steady progress and improvement in St. Lucia in many directions. In agricultural matters there has been considerable development, and there is abundant evidence of increasing interest, much new cultivation being started. Were it not for the deplorable condition of the sugar industry, the whole outlook would be much more favourable. The export of fruit and vegetables is one branch of agriculture which promises well for the future, and steps are being taken to introduce at an early date measures for the proper inspection, grading and packing of all fruit exported from the island.

The export of sugar during 1929 amounted to 4,536 tons, as against 4,100 tons in 1928. The average export price, however, was very low, being £12 10s. per ton. Practically all the rum produced in the Colony is consumed locally, but last year 2,013 proof gallons were exported. Cacao, limes, coconut products and bananas also enter into the export trade of St. Lucia, cacao being shipped to the extent of 8,906 cwt.; limes 37,345 barrels ; coconuts to the number of 295,983 ; copra, 7,195 cwt.; and bananas, 6,818 bunches. The total value of exports last year amounted to £199,000, which was about £1,200 more than the value of shipments in the previous year.

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

The Manufacture of Synthetic Camphor and Synthetic Borneol.

A process has been established for the manufacture of camphor and borneol on a large scale from turpentine oil. The process can be used profitably if the price obtained for the synthetic camphor is from four to five times that of turpentine oil. Limonene and fenchene are obtained as by-products and may be sold at half the price of turpentine oil.

The process consists of heating the *a*- pinene fraction of turpentine oil with salicylic acid in a closed vessel at a pressure between 1.25 and 1.5 atmospheres. Borneol salicylate is formed. When esterification is complete, the by-products and any unused pinene are distilled off and eventually fractionated. The residual salicylate is hydrolysed with dilute caustic soda under slight pressure. Free borneol separates and is filtered off on a metal gauze, is washed, centrifuged and recrystallised from alcohol. About 90 per cent. of the liberated salicylic acid may be recovered and used again. The borneol is dehydrogenated to form camphor by the action of highly active, reduced copper. The pure, dry borneol is dissolved in dry, water-clear xylene, the copper catalyst added, and the whole refluxed. When the reaction is complete the copper is allowed to settle and the clear solution of camphor is removed. The copper may be used again. The xylene is volatilised and recovered. The camphor crystallises and is collected.

The production of 100 kg. of camphor requires 180-200 kg. of turpentine oil, and 10-12 kg. of salicylic acid are lost.—(*Pharm. Ztg.*, p. 1275, Vol. 75.)

* * *

Pectins from Lemon Residues.

In view of the increase in the production of citric acid from molasses by fermentation, by-products of the citrus industry assume increasing importance. Lemon residues or "pastaccio" contain 15 to 19 per cent. of pectin which, after suitable treatment, can be profitably recovered. The wet residues contain 80 per cent. of water. The dry matter has the following percentage composition: ash 4 to 4.2, fats, resins, and waxes 24 to 35, cellulose 19 to 22, lignin 8.4 to 9.2, groups forming furfuraldehyde 8 to 9.5, reducing sugars 1.2 to 1.8, hemicellulose, gums, &c. 9.2 to 15.7, pectins 15 to 19, and some nitrogenous substances. The most satisfactory method of separating pectin is by precipitation with alcohol. It is proposed to replace the inevitable losses of alcohol by fermenting the carbohydrates in the lemon residues. With this object, the residues are initially treated with twice their weight of 0.05 per cent. hydrochloric acid at 103° to 105°. The polysaccharides are thereby hydrolysed to simple, soluble carbohydrates which may be fermented. The solution is filtered and concentrated to one half of its volume in a triple effect apparatus. It is then fermented with yeast. The liquid is cleared by centrifuging and then contains pectin and a certain amount of alcohol in solution. It is treated with an equal volume of 96 per cent. alcohol to precipitate the pectin. The solid pectin is filtered off and freed from alcohol and water in a vacuum desiccator. The filtrate, consisting of dilute alcohol, is concentrated in a rectifying column and may be used again, any loss being replaced by alcohol produced by fermentation.—(*Brit. Chem. Abs. B.* p. 1168, 1930.)

* * *

Concentrated Fertilisers.

Increasing attention has within recent years been paid to the manufacture and use of concentrated complete fertilisers which contain, weight for weight, more than twice the amount of plant food occurring in ordinary mixtures. Such fertilisers are quite new to the United Kingdom although they have been in use for some years on the Continent. For estate work, particularly in the Tropics, where transport costs and bulk are grave factors which limit the use of fertilisers, they are also in considerable demand.

The process of manufacture allows several analytical variations to be made and it has been found possible to produce grades of concentrated fertiliser suitable for all climatic and soil conditions. Four of these, the ammonium-phosphate series, contain no potash and are known as concentrated N.P. fertilisers. Their percentage analyses are as follows:—

N.P. Series.	*Nitrogen.*	*Phosphoric Acid.*
Type A	14.3	43.0
,, B	18.0	18.0
,, C	16.0	32.0
,, D	12.3	56.5

The remainder are complete fertilisers containing nitrogen, phosphates, and potash. They are granular and are known as concentrated complete fertilisers Nos. 1, 2, 4, 5, 6 and 7. These are their percentage analyses:—

Complete Series.	*Nitrogen.*	*Phosphoric Acid. Water Sol.*	*Insol.*	*Potash.*
No. 1	12.5	12.5	..	15.0
No. 2	10.4	10.4	..	20.8
No. 4	10.4	20.8	..	10.4
No. 5	8.0	16.0	5.5	16.0
No. 6	7.5	26.0	6.0	7.5
No. 7	6.5	22.5	3.0	13.0

Such high concentration has been made possible by the success of chemists and engineers in replacing the usual sources of nitrogen and phosphoric acid by the chemical combination, ammonium phosphate. It is only by the union of this ammonium phosphate with potash that complete fertilisers of such high analyses can be made.—(*The Fert. Feed. Stuffs and Farm Supplies Journal*, Vol. XVI, No. 1.)

SUGAR NOTES.

Compiled by the College Department of Sugar Technology.

Mechanical Transmission of Sugar-Cane Mosaic. *Miss G. Wilbrink.*

In tests made in Java to ascertain whether sugar-cane mosaic is transmissible by mechanical means, 30 healthy stools of E.K. 28 growing in ten tubs were cut down when about three months old, a sterile knife being used in the canes in half the tubs and one contaminated with mosaic on the remainder. The tubs were then kept in an isolated place in the open. Later, the stools in two of the tubs containing canes cut with the infected knife showed, respectively, 10 and 12 diseased sprouts, the stools in the other tubs remaining healthy.

In a further experiment, in which the more susceptible D.I. 52 canes were used, five adjacent rows each containing ten healthy stools of six-months-old plants were cut down, the cut canes being used as seed pieces; a sterile knife was used in three of the rows (which were cut down first), and a contaminated knife on the two remaining rows. Adjacent plots were then planted with the seed pieces, each with the cutting of one row. About 15 per cent. of the plants in the plots sown with seed-pieces cut with the infected knife showed infection, none of the others becoming diseased during the three months following planting. Under the conditions of the experiment the chances of insect transmission playing any part in infection were considered to be slight.

In a third test, 15 sets of healthy E.K.28 cane were cut with a sterile knife and planted in an insect-proof cage, 15 sets of the same origin, but cut with a contaminated knife, being similarly planted. In each cage 13 sets produced stools, and three months later five stools from the canes cut with the contaminated knife showed mosaic, though all the controls remained healthy. This result is considered to afford definite proof that mechanical transmission of sugar-cane mosaic can take place on the cutting knife.—(*Rev. Appl. Mycol.* Vol. IX, Pt. 10.)

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Cleaning Evaporator Tubes. *Geo. D. Becker.*

Previous to the 1929 crop, the practice at Honomu was to boil out the evaporator on Saturday nights under the usual conditions as followed through the Islands, *i.e.*, to each cell was added a bucket or two of cleaning material to a certain volume of water contained in the effect, boiled, washed and brushed the following day. But during 1929 a method was devised for boiling out the evaporators that not only reduced the amount of cleaning material, but almost entirely eliminated the Sunday brushing of the tubes, which method was as follows: The cleaning solution was made up in a conveniently located tank, a solution of approximately 25 per cent. caustic soda, and in sufficient quantity to supply all cells. This alone facilitated quicker manipulation and allowed frequent succeeding boilings with the same solution, only maintaining a fairly constant concentration by the addition of more cleaning materials when needed. A phenolphthalein test was used for determining the strength of the solution. Each cell of the effect was filled to the top of the steam-chest with the prepared cleaning solution; vacuum was obtained on all cells but the pre-evaporator, steam was introduced to the first cell steam-chest; and, when sufficient temperature was reached, the boiling out of the cells was started. In the boiling out of the cells the same methods were used as in the case of juices, that is, functioning as though juices were being handled. It required from three to four hours to boil out, depending on the amount of constitution of the scale adhering to the tubes. Water was added to each cell during the boiling-out process in order to maintain a fairly constant level of the cleaning solution. On some occasions it was very advantageous to add a small amount of screened furnace ash to the extremely dirty cells, such as the fourth body. In this method violent circulation of the cleaning solution was obtained, and, due to this circulation and to the addition of the ash, a mechanical as well as chemical cleaning of the tubes effected. Due to this method of cleaning evaporator tubes, Honomu has found it unnecessary to brush the tubes by hand except on rare occasions. For instance, during the 1929 crop, lasting 30 operating weeks, the evaporators were brushed only four times, consequently a reduction in Sunday labour was realized, amounting to $396.72 for the crop, while the cleaning materials account showed a saving of $744.73; the brushes used were greatly reduced and therefore gave a saving of $52.00, giving a total of $1,193.45 saved by this change of method. This does not take into consideration the material saving to the apparatus by the elimination of the frequent brushing necessary in the former method. Another pleasing condition of this method was the lack of necessary mechanical changes usual to a change in any cleaning operation. This method worked extremely well at Honomu. It saved in the neighbourhood of $170.50 per operating month. That it will prove as satisfactory in another factory cannot be said. It is certainly worth a trial. (*The Inter. Sugar Journ.* Vol. XXXIII, No. 385.)

ACKNOWLEDGMENT.

We are indebted to the Dixie Culvert & Metal Co., New York City, for presenting us with three copies of their *Handbook of Culvert and Drainage Practice*. This publication supplies a long felt want in that it provides engineers with very useful data in research and design in the solution of practical drainage problems.

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR—Prices on the Home Market have ranged as follows (c.i.f. per cwt.):

	Foreign. s.	d.
2nd January	5	6
8th January	6	3
15th January	6	1½
22nd January	6	2¼
29th January	6	1½
5th February	5	10½
11th February	6	0
Preferential at	9	4½

Up to the end of January generally dull and uninteresting conditions prevailed in the sugar markets and according to *Messrs. C. Czarnikow, Ltd.* little business of any outstanding importance had been transacted. Although values have remained about steady buyers have shown the minimum of interest. Quite apart from the fact that the Trade on both sides of the Atlantic appears to be in a sufficiently comfortable position for the time being, so far as nearby requirements of Raws are concerned, there is a general disposition amongst buyers to abstain from entering into any important commitments until the agreements recently reached on the Continent have been finally ratified. Whilst there can be no question of any actual shortage, the Conference scheme would undoubtedly do much towards the levelling of the uneven balance of Supply and Demand. This process, however, will be a gradual one as the Conference agreements are to operate over a period of five years and are designed to assist the return to economic conditions than to face a sudden rise in prices.

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RUBBER.—Quotations for Plantation Sheet have ranged as follows:—

	d.
2nd January	$4\frac{3}{16}$
7th January	$4\frac{1}{8}$
14th January	$4\frac{1}{4}$
21st January	$4\frac{3}{16}$
28th January	$4\frac{1}{16}$
4th February	$3\frac{7}{8}$
11th February	4

Until the end of January the market has been dull and inactive, prices having moved slightly with a rather downward tendency. The plantation outputs so far published show a reduction of something less than four per cent. compared with December last year, and in view of the existing heavy stocks in the United Kingdom, the U.S.A. and elsewhere, it looks as if too much rubber is still being produced.

COCOA.—Since our last report we regret to say that the Federation on the Gold Coast has lost control and farmers are now offering their cocoa freely. Under this pressure the market has gone to a record low level, and in New York as low as five cents has been accepted. It is felt, however, the low market is only of a temporary character, as much of the cocoa held on the Gold Coast will be unfit to comply with the regulations governing the importation of defective cocoa into the United States of America.—(*By courtesy of the Cocoa Planters' Association, Trinidad.*)

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COTTON.—The following are the official spot prices in pence per lb. of the Liverpool Cotton Association:

	American Mid.	*Egyptian F. G. F. Sakel.*	*Sea Island.*		
			Good.	*Extra fine.*	*Prices paid this Week.*
2nd Jan.	5·33	7·70	21·00	36·00	—
9th Jan.	5·40	7·95	20·00	35·00	19·87-20·12
16th Jan.	5·41	8·20	20·00	35·00	15·00 —
23rd Jan.	5·63	8·55	20·00	35·00	—
3rd Feb.	5·61	—	19·00	34·00	—
10th Feb. .... (local)	5·77	—	19·00	34·00	—

The market for American has been quiet and fluctuations in values have been of the smallest proportions. The Egyptian ring, on the other hand, has been comparatively active. The statistical position of American cotton still remains poor.

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TEA AND COFFEE.—The tea trade according to the *Times Trade and Engineering Supplement* for 24th January has begun the new year with healthy demand, but not with any particular price changes of note. Latest averages per lb. include Ceylon, 17.62*d.*; Indian, 14.45*d.*; Java, 10.9*d.*

The fall in Brazilian coffee is regarded by European reviews of the trade as the event of 1930. Colombian has sold at 100*s.* to 110*s.*, and Costa Rica at 100*s.* to 156*s.*, Jamaica 200*s.*

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BANANAS.—Jamaicas are in poor to fair demand, and unchanged at £19 10*s.* per ton delivered (London), and £19 delivered nearest railway station; the price to retailers is about 10*d.* to 10½*d.* per dozen. The demand for Brazilians continues weak with the price unchanged at £18 per ton delivered nearest railway station.—(*West India Committee Circular*, 22nd January.)

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LIME PRODUCTS.—*Lime Oil.*—Handpressed is dull and inactive with sellers willing to meet the market. Distilled is firm with further sales at 30*s.* to 32*s.* 6*d.* *Lime Juice.*—Concentrated is neglected and valued nominally at £8. Raw continues quiet with the value (2*s.* 6*d.* to 3*s.* according to quality) unchanged.—(*West India Committee Circular*, 22nd January.)